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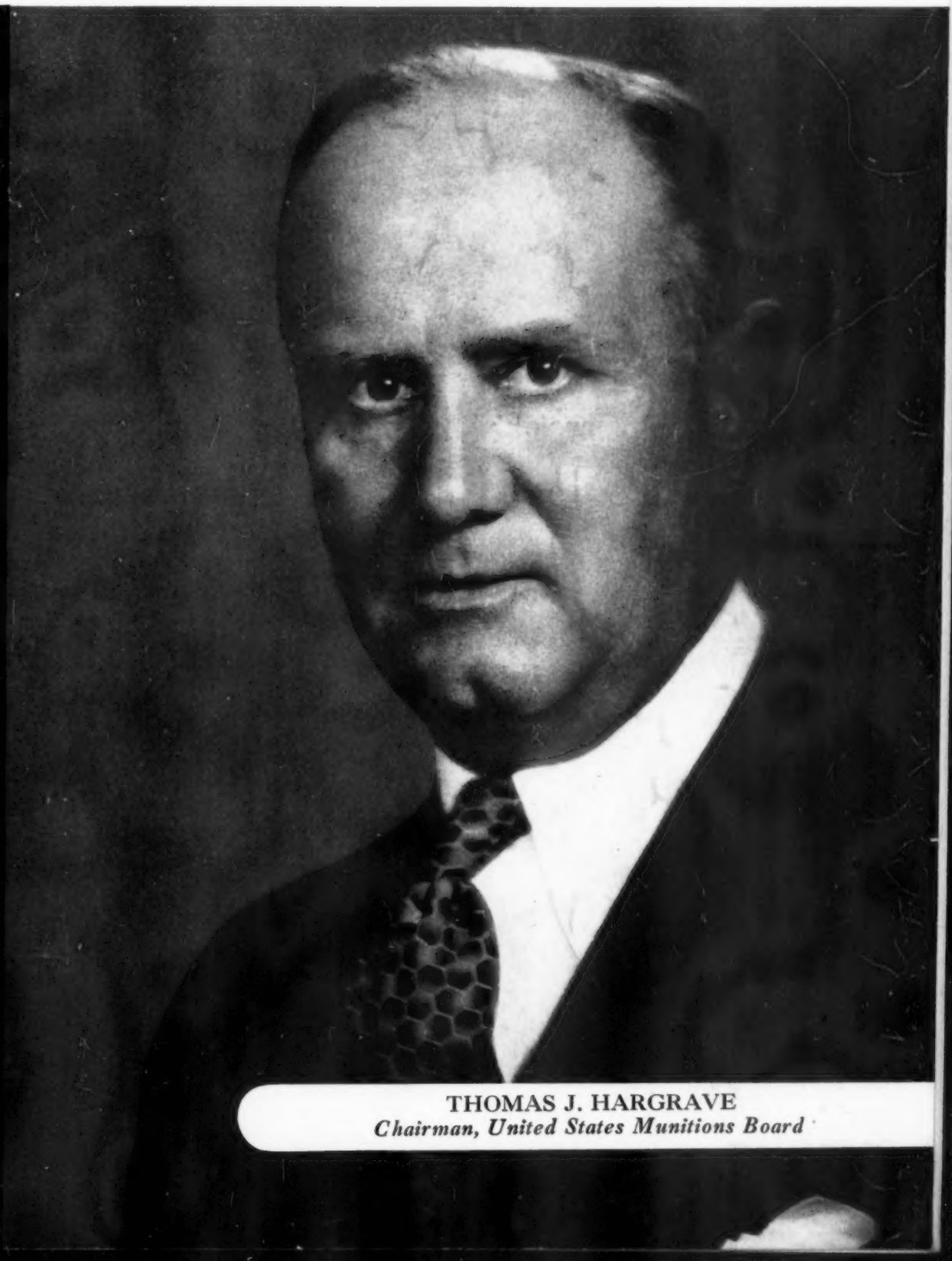

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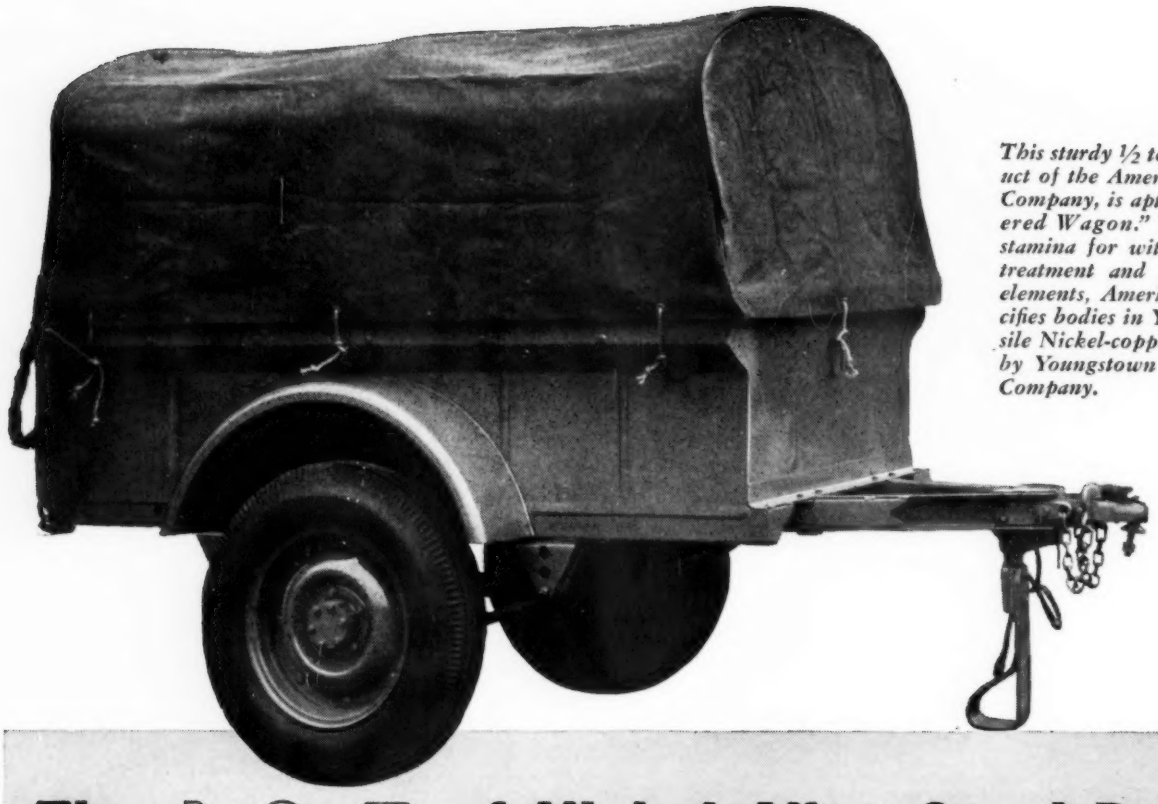

This sturdy ½ ton trailer, a prod uct of the American Bantam Ca Company, is aptly called a "Cov ered Wagon." To assure extra stamina for withstanding rough treatment and exposure to the elements, American Bantam spe cifies bodies in Yoloy, a high ten sile Nickel-copper steel produced by Youngstown Sheet and Tube Company.

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THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

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THE LONG-RANGE AIMS AND PURPOSES OF THE ARMY ORDNANCE ASSOCIATION

1. Adequate national security. This is the great goal of peace. It is best obtained through a nonpartisan and persistent national policy which will ensure that the amount of military power—ground, sea, and air—available to this country and its probable friends will never be less than that available to its probable enemies.

2. Adequate munitions power. This is one of the two basic foundations of military power. The amount of it in quality and quantity available to the United States and its probable friends for timely and effective use should never be less than that available to its probable enemies.

3. Adequate military man power. This is the other main foundation of military power. The amount of it available to the United States and its probable friends should likewise never be less than that required for the timely and effective utilization of the munitions power essential to victory.

4. An ideal basis for achieving adequate munitions power. Existing stocks of munitions plus expected production should equal requirements both in quantity and quality at all times. Consequently, the more the United States can depend upon and speed up the mobilization rate of American industry, the smaller the stocks we have to maintain, the more up to date our munitions in time of conflict, and the less the cost.

5. To achieve the above objectives the following principles are advocated:

a. Designs of military armament that are second to none.

b. Existing stocks of combat and other munitions that are adequate in quantity and quality.

c. Efficient and dependable industrial mobilization with maximum shortening of the time factors involved, including the political time factor, the administrative time factor, and the industrial time factor.

d. Current and constant education, training, and development of the military-science-industry team.

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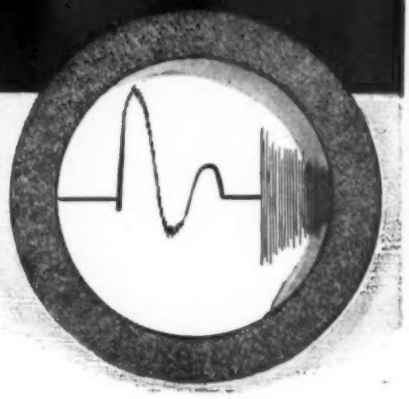

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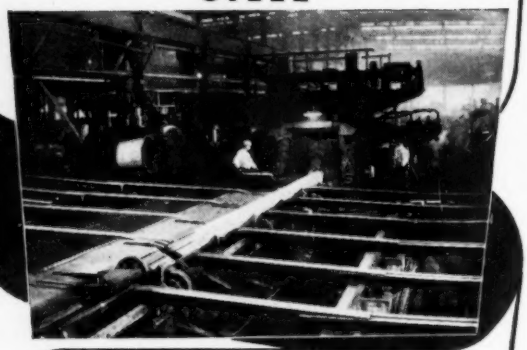

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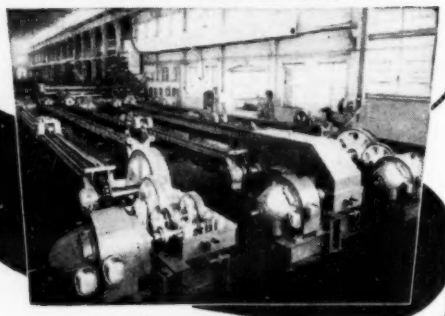

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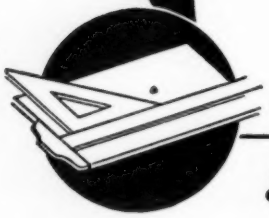

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New Developments

GROUND

TASK FORCE FURNACE TEST

Army equipment, ranging from tanks to T-shirts, is being rigorously tested by Task Force Furnace in the sun, heat, wind, and sand of the Arizona Desert.

The equipment, some of it standard for other climates, some of it new, was given to the Task Force, without any indication of whether it was experimental, approved, or in what opinion it was held in Washington, for unbiased trial.

One item was an attempted improvement over the standard tropical "Frank Buck" helmet—a flatter, coolie-type hat streamlined to circulate air against the wearer's head. It works well but is too insecure and troublesome for intensive activity and probably will get an adverse report.

The most applauded item to date has been a work suit made of 3-ounce nylon instead of the standard 8-ounce twill. It is cool and strong and launders almost as easily as a pair of stockings.

To test three types of gas masks, they are being worn an hour a day by twelve GI "guinea pigs" at their regular duties.

Comparative tests are showing up a number of possible economies. A dust respirator made of rubber and metal and nearly as complicated as a gas mask turned out in use to be less feasible than a simple felt mask similar to that used by surgeons.

In the gun division there are many innovations—an 81-mm. mortar with a special mount; the old 16-mm. mortar adapted as a one-man weapon; the M1 rifle modified to fire eight shots fully automatic in one version and twenty rounds in another, with several experimental light folding bipod rests to assist aim when firing from the prone position.

"RICE-GRAIN" VACUUM TUBE

A radio tube only a trifle larger than a grain of rice has been developed by the tube laboratory of the National Bureau of Standards. This "rice-grain" tube, known as a "microtube," is but one development of a basic and applied research program on vacuum tubes, undertaken by the laboratory in collaboration with industry, for military and industrial uses.

ARMY SURVEY OF SCIENTISTS

The War Department recently announced results of the first of a series of nation-wide surveys designed to ensure more economical use of the scientific talent of the United States in event of another war.

The survey, conducted by the American Chemical Society in conjunction with the War Department's Research and Development Division, indicated that the armed services in the last war did not make full use of the Nation's scientifically trained man power. As a result of this survey and others to follow, the Army expects to revise its classification systems so as to place trained scientists in positions suitable to their educational and practical backgrounds.

The poll of 31,000 recognized American chemists will be followed by similar surveys now being conducted or planned by the Institute of Physics, the Union of Biological Societies, the Geological Society of America, the American Association of Petroleum Geologists, the Association of Professional Geographers, the American Mathematical Society, the Engineers Joint Council, and the American Psychological Association.

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It's good business to use A.S.F. steel castings—and it will pay you to learn why. Let us send you an interesting A.S.F. case history. Write for *your* copy of "This Job's Done . . . Is Yours?" No obligation.

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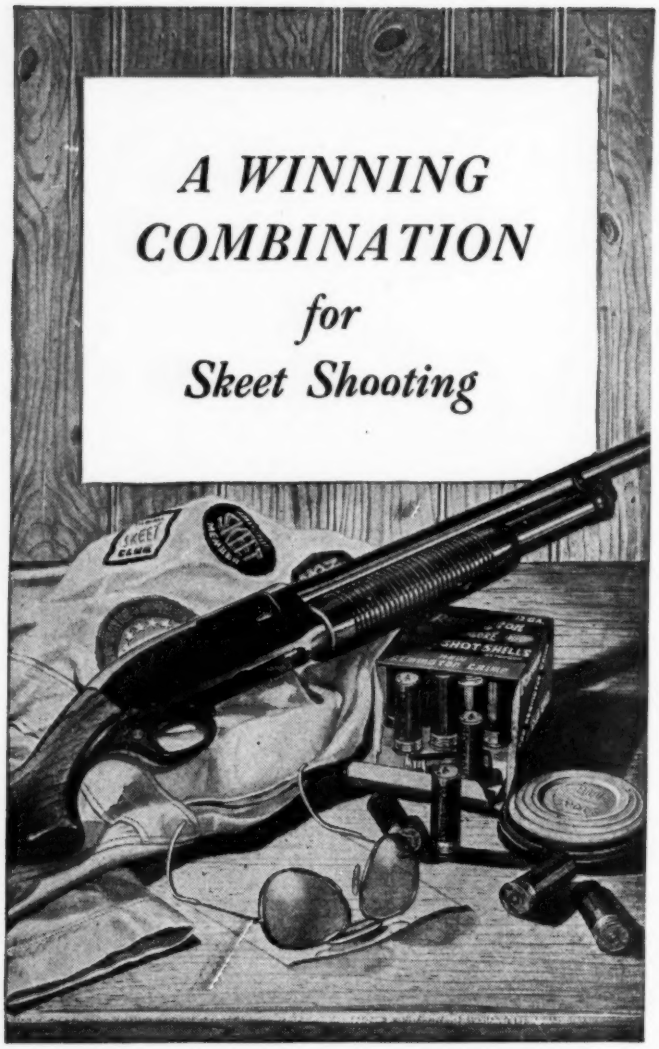

Skeet is a great sport—one you can enjoy for years to come. However, your fullest appreciation comes as your skill increases. And that's when you find that the *right* gun and the *right* ammunition count most.

Champion skeet shooters have found a *winning* combination in the Remington Model 31 shotgun and Remington Shur Shot shells with the New Remington Crimp. The Model 31 is a pump action repeating shotgun which, during the war, aerial gunnery students nicknamed "the gun with the 'ball-bearing' action" because of its velvety-smooth operation. And Shur Shot shells with the New Remington Crimp eliminate "blown patterns" which cause those unexplainable misses. There is no top wad to obstruct the shot charge. Thus, you get even distribution of shot pellets with no holes or openings for targets to pass through unbroken.

For free literature on this popular combination, write Remington Arms Company, Inc., Bridgeport 2, Conn.

Remington

DUPONT

"If It's Remington—It's Right"

Shur Shot is a trade mark of Remington Arms Company, Inc.

New Developments

OPERATION SNOWDROP

A famous fighting parachute regiment of World War II will establish an airhead in up-state New York in the course of over-snow maneuvers next February.

The operation, to be carried out by the 505th Regimental Combat Team of the 82nd Airborne Division, supported by elements of the Ninth Air Force, will be a complete airhead operation, with heavy engineer equipment up to and including bulldozers brought in by air for construction of an airstrip. Resupply, evacuation, and reënforcement by air will also be tested in this operation.

The maneuvers, starting this November 1st and continuing until March 1, 1948, will be carried out at Pine Camp, New York. The operation has been christened "Snowdrop." It will come to a climax with the 72-hour attack for the airhead sometime between February 9th and February 29th. The jump zone will be near the eastern shore of Lake Ontario which, at that season, will be frozen over and unsuitable for a beachhead operation.

NEW MEDICAL SERVICE CORPS

Legislation creating a Medical Service Corps in the Regular Establishment makes it possible for the first time to give Regular Army commissions to specialists in the scores of fields now closely allied to medicine; to bacteriologists, entomologists, psychologists, sanitary engineers, pharmacists, chemists, electronics experts, and the like. These will be grouped together in a new corps under the Medical Department of the Army.

The need has been evident for a long time. Up to now the Medical Department has been made up of six corps—Medical, Dental, Veterinary, Pharmacy, Nurse, and Women's Medical Specialists. It has been possible to commission specialists in other fields only in the Reserve from which they could be called to service in a national emergency.

LIGHT-BEAM TELEPHONE

The Optiphone, an ingenious device which permits telephone communication over a narrow beam of white or dark red light, has recently been made public. The device provides single-channel, 2-way, break-in speech communication and consists of an optical unit, a control unit, a storage battery, and a field telephone. The complete unit weighs 145 pounds. Optical range is up to four miles during daylight and up to seven miles at night with dark red filter, depending on atmospheric conditions. The field telephone is used directly with the equipment for point-to-point communication.

PLASTIC-EMBEDDED RADIOS

Radios and electronic equipment, embedded in a plastic for protection against rough handling and atmospheric conditions, may open new fields for electronic devices in industry and the home.

The clear, transparent plastic is called NBS casting resin. It meets the special mechanical and electrical requirements of a material for shielding delicate tubes and circuits without interfering with the operation of the electronic equipment.

THE WORLD'S ARMIES

The strength of the armies of the various nations, based on estimates of U.S. Army officers, are given in a copyrighted article in the *Armored Cavalry Journal.*

Russia is credited with the largest, with 3,000,000 men under arms, despite demobilization of 17,000,000 wartime troops. China comes next with 2,700,000, followed by Great Britain with 1,500,000, the United States with 1,100,000, and Yugoslavia with 800,000 of which ten per cent are women.

Other estimates include: France, 150,000; Spain, 300,000; Argentina, 45,000; Bolivia, 15,000; Brazil, 100,000; Chile, 40,000;

Here you see a seam made by a tungsten arc operating in an argon atmosphere. No flux is used. There is no cleaning of the weld afterwards. The weld is homogeneous and solid throughout . . . no slag inclusions and trapped flux to cause weak spots.

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GERMAN RESEARCH IN WORLD WAR II

By COLONEL LESLIE E. SIMON

An accurate and dramatic record of Nazi science and business at war. Colonel Simon draws on his broad experience to explain—with examples—not only the extent to which the Germans succeeded or failed, but *why* they did.

This absorbing book analyzes the factors that kept many new devices from completion. It describes, organization by organization, the lack of coordination among scientific groups of the Army, Navy, and Air Forces; it reveals the jealousy that existed between scientists and engineers.

Of particular interest are the descriptions of new scientific developments relating to the more important researches in interior ballistics, terminal ballistics, exterior ballistics and fire control, aërodynamics, and instruments and measurement technique.

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FLYING DIVISIONS

Transporting an army to the front is the next step in the cycle of war, Gen. Jacob L. Devers, Commanding General, Army Ground Forces, stated recently. "In the near future," he said, "we will be able to fly a standard infantry division, with all of its armament, to battle. Our infantry battalions, with their artillery, are already airtransportable. When present Ordnance and Air Force developments culminate in a heavy, airportable tank, we can fly standard infantry regiments to the attack. When Engineer and Air Forces developments produce heavy engineer equipment which is airportable, we can fly a standard infantry division to war."

POWDER METALLURGY

A comprehensive list of powder metallurgy patents—a valuable source of technical information on this new and undeveloped science—has been compiled following an extensive study of patent literature in connection with an investigation in the field of powder metallurgy at the National Bureau of Standards. Representing more than a century of progress in this art, this information, which was obtained from a collection search of 2,253 patents and classified in related groups with a short abstract for each invention, has been made available to industry and others interested in this specialized field as NBS publication M184, "United States Patents on Powder Metallurgy," by Raymond E. Jager and Rolla E. Pollard.

SEA

FIRST "SOFAR" STATION

The first "Sofar" receiving station in the new Navy long-range, underwater sound system for locating air and ship survivors at sea, is located at Monterey, Calif. This station is the first of four which will be used to cover the Pacific. A second will be located at Point Arena, northwest of San Francisco, and the other two on separated islands in the Hawaiian group. All will be ready for use this year.

Sofar is a war-developed system coming as a by-product of submarine-detection studies. In tests made in the Atlantic over a year ago, sound was picked up 3,100 miles from its source. It is expected that this range will be doubled with improved equipment.

In the system, a bomb designed as standard equipment on lifeboats is dropped overboard by the survivors. It is triggered to be exploded by the water pressure when it has descended about a half mile. It is then in a layer of water which confines the sound waves within itself and transmits them for long distances. At the receiving station, recording equipment is connected by submarine cables to nearby hydrophones which are set deep in the water to receive the sound waves.

WORLD'S FASTEST SUBMARINES

Hull, machinery, and contract plans for the world's fastest combat submarines, recently authorized by Congress, are being prepared by the Navy Bureau of Ships and the Portsmouth Naval Shipyard, Portsmouth, N. H. The new submarines will be named the U.S.S. TANG and U.S.S. TRIGGER, honoring two World War II undersea fighters. *(Continued on p. 148)*

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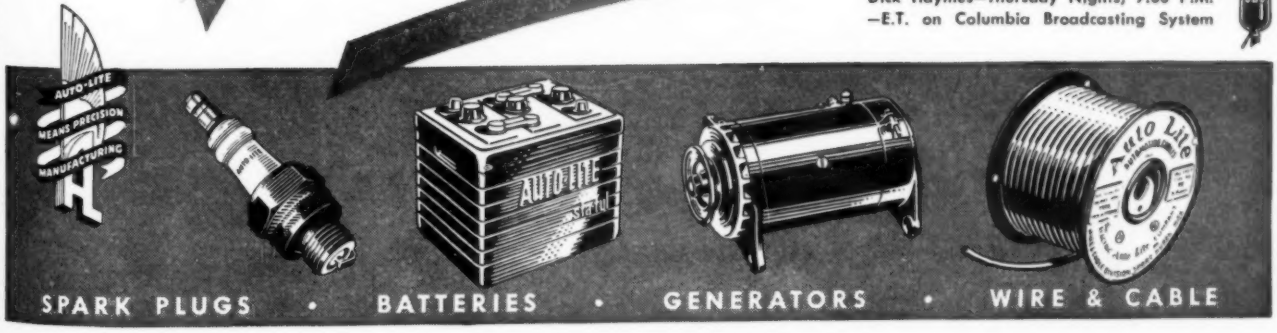

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New Developments

Scheduled for completion in 1951, the TANG and TRIGGER will be the first ships of the Navy's postwar fleet. All desirable enemy and allied wartime developments will be incorporated in their design. Final detail features, however, will not be fixed until near the end of their construction.

NAVAL EXPLOSIVES REGULATIONS

All ships and stations of the Navy have been advised of the establishment of a general policy to govern peacetime handling of ammunition and explosives in continental port areas.

Under the new regulations, loading and discharging of cargo ammunition in continental ports will be performed only at ordnance facilities or explosives anchorages, except in cases of emergency. When explosives anchorages are used, Coast Guard regulations will be observed.

ATOMIC-POWERED SHIPS

Vice Adm. Edward L. Cochrane predicted that future United States aircraft carriers would be even bigger than the present 45,000-ton Midway class and might use atomic energy power instead of fuel oil. He forecast the use of atomic power in many vessels in not less than five years and "more likely ten."

BETATRON TO X-RAY ARMOR

A 10,000,000-volt betatron which can take an X-ray picture of an inch-thick piece of steel in one second, almost as fast as a conventional camera takes a picture of its surface, has been built by the General Electric Company.

The machine, the first of its size to be produced for industrial purposes, will be installed in the Naval Ordnance Laboratory at White Oaks, Md., near Washington, D. C., where it will be used in the radiography of castings and weldments of naval guns, directors, armor plate, and other ordnance equipment for internal flaws.

NEW NAVY RADAR SYSTEM

Construction on the Navy's latest refinement in all-weather landing systems has been completed and the new ground controlled approach traffic system at the Naval Air Station, Quonset Point, R. I., is now ready for operation. The new radar system, first of its type to be installed anywhere, is operated from the airport control tower and combines the advantages of already proved Navy-Bendix GCA plus two new devices which will instantly identify aircraft in the approach pattern and determine the altitude of each plane.

Search and height-finding antennas have been raised on 67-foot steel towers in order to help eliminate "ground clutter."

One of the two new devices to be employed is a separate very high frequency radio identification indicator which flashes on a compass rose the bearing of any plane communicating with the tower on voice radio. Second of the new devices is a radar height-finding antenna, indications of which appear on a scope adjacent to the all-around control scope. The zone air controller can point the antenna in any direction and immediately determine the altitude of the plane appearing on the height-finding grid.

AIR

A NEW HELICOPTER

A new 5-place helicopter, the XR-12, has been designed and built for the AAF by the Bell Aircraft Corporation and is now undergoing preliminary tests at the manufacturer's plant at Buffalo, N. Y.

The XR-12 has a top speed of 105 miles an hour and an operating speed of 90 miles an hour. Its service ceiling is 13,000 feet

They're clearing the way in Warsaw

FEW CITIES on the earth felt the horror of war's destruction more than Warsaw, Poland. There, in the poor and barren Ghetto quarter, the invader blasted and tore the heart from a community—leaving little but rubble and smoking ruin behind.

Today, on that shattered scene, rebuilding has begun. And in Warsaw, as in hundreds of other tragically broken places, "Caterpillar" Diesel Tractors are clearing and remoulding the shattered face of the land.

Here again, "Caterpillar" proves its adaptability to the present need. The "Caterpillar" Diesel Tractor that built roads and airports for victory through more than four years of war now delivers to a hopeful city the magic of rebirth.

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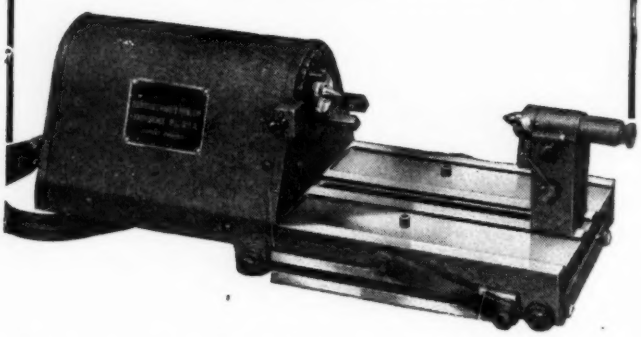

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and its hovering ceiling is 4,350 feet. It has a range of 300 miles and can climb vertically at the rate of 450 feet a minute.

A 2-bladed main rotor system, 47 feet, 6 inches, in diameter,

The Bell XR-12 helicopter.

is used with a gyroscopic action stabilizer bar which, weighted at each end, is attached to the hub at right angles to the blades to give greater stability to the blades and to decrease vibration.

LIGHTWEIGHT TURBO JETS

The air industry's dream of developing a simple and economic lightweight engine, capable of producing a high rate of horsepower per pound of engine, may be realized with the development of two lightweight gas turbine engines by the Boeing Aircraft Company.

The engines are the Boeing Model 500 turbo jet, producing 150 pounds of thrust and weighing only 85 pounds, and the Boeing Model 502 turbo prop, delivering 200 shaft horsepower with a weight of but 140 pounds. This compares with a weight of approximately 500 pounds for a 90-horsepower automobile engine.

Model 500 turbo-jet engine is twenty-nine inches in length by twenty-two inches in maximum diameter. Model 502 turbo prop is forty-two inches in length by twenty-two inches in maximum diameter.

UNDERGROUND FACTORIES

On the basis of available evidence presented by Air Matériel Command analysts, the Army Air Forces believes that complete underground structures represent the most practical available protection against air attacks.

By the end of the war the Germans had a total of 143 underground factories in production. Approximately twenty per cent of the entire capacity of the airframe industry, including virtually all the V-weapons and nearly sixty per cent of aircraft engine production facilities, had been placed underground.

The Mittelwerke and Nordwerke factories near Niedersachawerfen were situated beneath a steep, heavily wooded hill that rose almost 300 feet above the surrounding flat countryside.

At Niedersachawerfen in the Harz Mountains the largest and most ambitious underground facility in the world was located. Here the V-1 and V-2 projectiles, aircraft rockets, and parts for engine and rocket bombs were manufactured.

While the German experience clearly indicates that almost every type of small and moderate size plane can be produced underground, AAF and AMC officials say that no insight is afforded as to the potential suitability of underground construction of aircraft the size of the B-29 or B-36.

A 42,000-POUND BOMB

A B-29 Superfortress bomber has been modified to carry the heaviest bomb ever made—a 42,000-pounder. A part of the body section under the plane's wing had to be cut away to make room for the huge bomb. Although the missile is the heaviest air-borne bomb load in the history of war planes to date, the Air Forces Ordnance division also has been working on the production of bombs weighing up to 100,000 pounds.

New MODEL 1947 JOHNSON LIGHT MACHINE GUN

BY JOHNSON AUTOMATICS

SPECIFICATIONS

WEIGHT—15 pounds Capacity 25 shots.

CALIBERS — .30'06 — 7.92 mm. — 7.65 mm. — 7. mm. — and comparable military cartridges.

MAGAZINE — 20 shot detachable single column box.

TYPE OF FIRE—Full or semi-automatic.

CYCLIC RATE OF FIRE— 750 — 800 rounds per minute.

DELIVERABLE RATE OF FIRE — Semi-automatic 80-100 rounds per minute. Full automatic 300-350 rounds per minute.

TYPE OF MOUNT—Monopod adjustable to nine positions.

TYPE OF ACTION — Short recoil with gas assist.

The Model 1947 Johnson Light Machine Gun includes a number of new developments. These improvements are the results of battle experience with the Model 1941 Johnson Light Machine Gun by the U. S. Marines, the 1st Special Service Force, U. S. Army, and other United Nations Forces—plus several years of factory research and development.

In the *History of the 1st Special Service Force,* Lt. Col. Burhams says, **"The Johnson [Light Machine Gun], pound for pound, was the most valuable armament it [The First Special Service Force] possessed."**

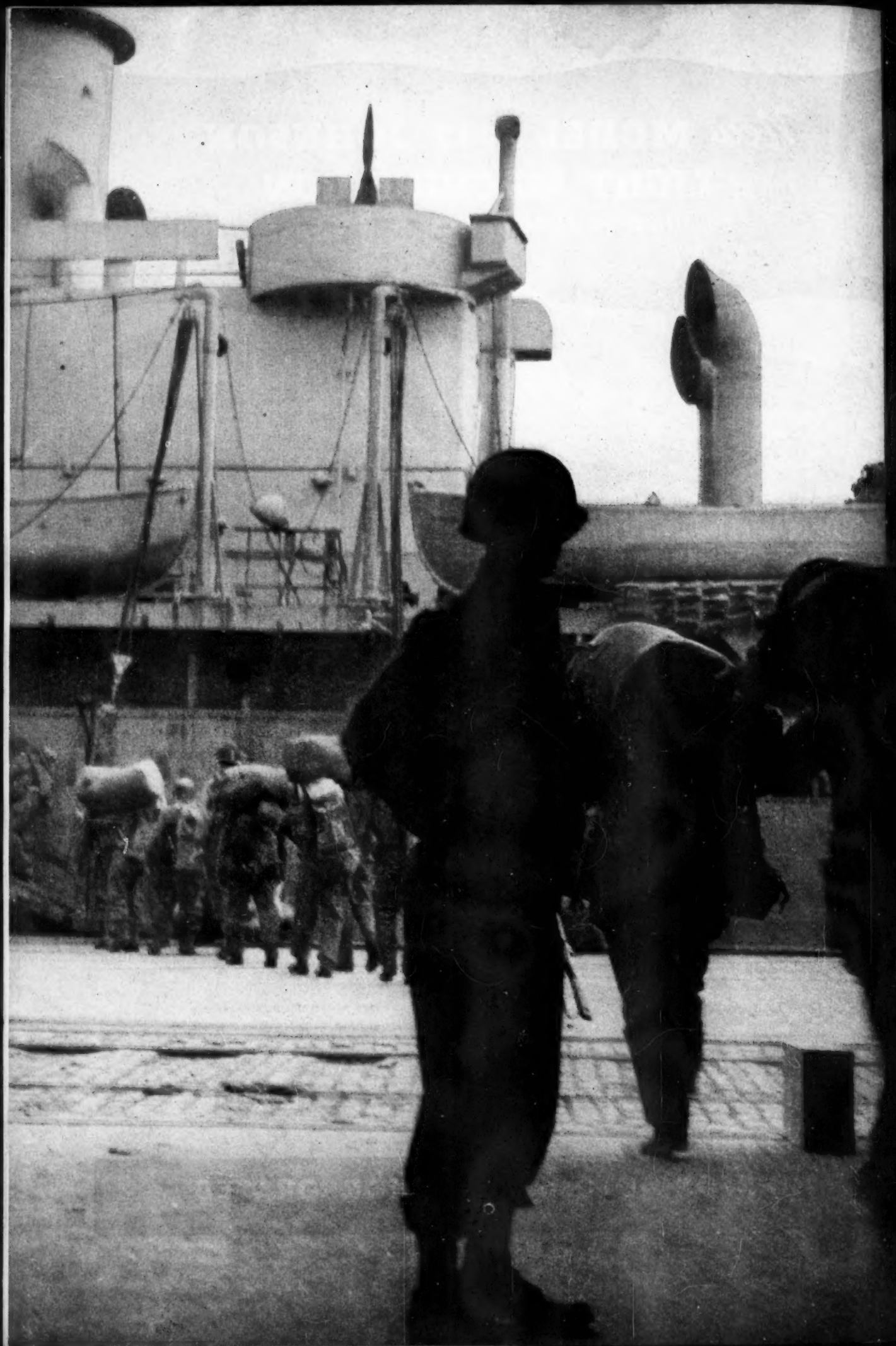
The 1947 Model can be used from the shoulder to fire single shots like a rifle, or from its monopod mount it can give barrage fire at delivered rates up to 300-350 shots per minute. The fast barrel change (10 seconds) allows a maintained rate of fire of over 150 rounds per minute with three barrels (total weight less than 25 lbs.) for as long a period as necessary. A three man crew equipped with a Johnson Light Machine Gun and two extra barrels has fired 10,000 rounds in 2½ hours.

New features include (1) gas assist assembly which increases the cyclic rate and gives greater power for operation of a dirty gun; (2) Johnson Battle Range Sights, giving immediate alignment for extra long, point-blank range, or ½ minute adjustment for fine accuracy up to 1200 yards; (3) new and simplified disassembly—all major parts can be disassembled in less than one minute; (4) a tubular stock of special damage-resistant plastic.

For all purposes from actual military-rifle training practice to barracks recreation or home party fun. Price complete with home target gallery—$15.00

Johnson *INDOOR* TARGET GUN

JOHNSON AUTOMATICS, INCORPORATED



The Munitions Board

Industrial Mobilization Planning Comes of Age

AS chairman of the Munitions Board, Thomas J. Hargrave occupies one of the most important top-level positions in our new defense establishment. The Munitions Board succeeds the Joint Army and Navy Munitions Board. It will carry on a variety of pivotal activities of the utmost importance to the safety and general welfare of the Nation.

The primary function of the Munitions Board is to support the strategic and logistic plans prepared by the Joint Chiefs of Staff. To accomplish this task the Board will carry on the following nine activities:

1. Coördinate the industrial procurement, production, and distribution plans of our defense establishment;
2. Plan for the military aspects of industrial mobilization;
3. Recommend the assignment of procurement responsibilities among the several services, plan for the standardization of specifications, and strive for the single procurement of equipment used by all three services;
4. Prepare estimates of potential production, procurement, and personnel for the purpose of supplying a basis for the evaluation of the logistic feasibility of strategic operations;
5. Determine relative priorities of the various military procurement programs;
6. Supervise subordinate agencies that may be created to consider special subjects;
7. Make recommendations to regroup, combine, or dissolve existing interservice procurement, production, and distribution agencies so as to promote efficiency and economy;
8. Maintain liaison with other agencies in order to correlate military and civilian requirements, particularly with regard to the procurement, maintenance, and disposition of strategic and critical materials;
9. Coördinate the material and personnel requirements of the Joint Chiefs of Staff and those of the various agencies assigned to meet military needs.

The man who will direct, guide, and supervise these key activities, Thomas J. Hargrave, is president of Eastman Kodak Company, one of the most progressive and successful industrial enterprises in the United States.

Kodak is as typically American as baseball, or pork and beans. It has been able, in a rather unique degree, to make the fruits of scientific discoveries available to the common man. It has enriched the every-day activities of millions of people everywhere, giving them a keener thirst for beauty and a practical, inexpensive way of capturing it for future enjoyment.

Kodak plays an indispensable rôle in hospitals, industrial laboratories, research centers, in all types of educational institutions, in the amusement world, in the publishing, military, and other fields.

DURING World War II the Eastman Kodak Company not only intensified its photographic operations but assumed the additional burden of producing a strange product called RDX. This powerful new explosive gave our combat forces a tremendous advantage over the enemy and hastened the victorious conclusion of the war.

Kodak's many achievements are a good indication of the type of industrial statesmanship for which Thomas J. Hargrave is justly renowned. He has been a constructive force in his company for nearly a quarter of a century. He brings the qualities of integrity, competence, and vision to the Munitions Board during its formative stages when so much depends upon mature decisions.

We are confident that, during the present global crisis, the Munitions Board will keep constantly abreast of rapidly changing conditions and of new developments and discoveries.

We feel sure that in this fast-moving atomic age the Board will revise, improve, or modify current industrial-mobilization plans from year to year, and will give the Nation maximum combat strength without wasting one penny of the taxpayers' money.

Thomas J. Hargrave was president of the Eastman Kodak Company and was rounding out twenty-one years of association with that organization when he was chosen by President Truman to be chairman of the Munitions Board.

A native of Wymore, Nebr., Mr. Hargrave is a graduate of the University of Nebraska and of Harvard Law School. His legal career with a Rochester law firm was interrupted by military service.

He served first as a cavalry private on the Mexican Border in 1916 and 1917. He was a machine-gun captain in France in 1918 and was awarded the Distinguished Service Cross for extraordinary heroism in action by Gen. John J. Pershing. He also received the French Croix de Guerre.

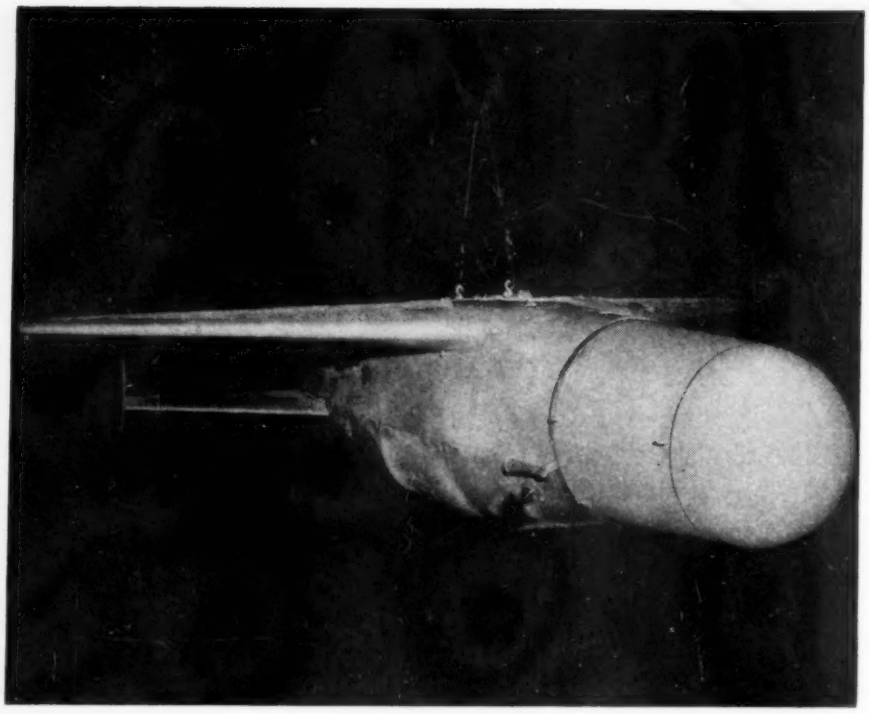
Back in Rochester after the war he resumed law practice with his former associates. Six years later, George Eastman asked him to head his company's legal department. Mr. Hargrave became the company's part-time general counsel and also continued his private law practice. He was elected secretary and a director of the company in 1928.

Four years later, in 1932, Mr. Hargrave was still on part time with Kodak as a vice-president.

He began to devote full time to the expanding interests of the photographic company in 1934 as vice-president and secretary, and in May 1941 became its president.

On June 18, 1947, President Truman appointed Mr. Hargrave Chairman of the Munitions Board in the new Defense Establishment.—THE EDITORS.

GOING OVER. — *The Army Transportation Corps carried more than seven million troops and other personnel from the United States to overseas theaters during World War II.*



Trends in Guided Missiles

Potentialities of These Weapons Should Never Be Underestimated

by

Lieut. Col. William L. Clay

"The advent of the guided missile using jet propulsion has extended the range, speed, and altitude of both offensive and defensive weapons to unbelievable figures."

IT IS the intention of this article to present, in nontechnical terms, a brief over-all picture of the trends in guided-missile development in this country up to the present time. A brief historical background of guided missiles, together with several reasons for their development, is believed essential in order that the reader may better evaluate the progress made in this new field.

The development of guided missiles as weapons of war was probably first conceived by the Germans in the early 1930's. Previous to that time a number of independent rocket societies had been organized, but their experiments were conducted only on a limited scale. However, the Germans, in their preparations for war, realized the potentialities of such weapons, and consequently the best qualified German scientists and unlimited money were devoted to their development.

Germans Were Prepared

As far as quantity and types were concerned, the German program was not too far different from ours. However, they had initially obtained considerably more experience in rocket design and supersonic aërodynamics, and therefore were more adequately prepared to adapt this knowledge to guided-missile design. However, our knowledge of radio devices, radar equipment, and control systems was at least equivalent to theirs.

Throughout the history of warfare, speed, range, and altitude have been the primary considerations in the development of more effective ground and air weapons. Although uncontrolled rockets have been used for hundreds of years, the development of the art of gunnery in the latter part of the nineteenth century obscured the use of rockets for warfare. As a result, in the first World War the range of conventional artillery was limited to twenty miles. In the second World War, the tremendous improvement in aircraft performance extended the effective range of explosive missiles to 3,000 miles. However, this proved to be a very costly method.

But the advent of the guided missile using jet propulsion has extended the range, speed, and altitude of both offensive and defensive weapons to unbelievable figures. For instance, the German V-2 which was used to bombard London and Antwerp attained a maximum speed of 3,800 miles an hour and reached an altitude of 60 miles.

Automatic Operation

Another factor under consideration is the attempt to eliminate the restrictions imposed by the human mind or body on the ultimate effectiveness of these weapons. The inability of the human body to withstand the high accelerations present in launching these missiles or in maneuvering them against moving targets makes it essential that some method of automatic operation be utilized which can be controlled from a remote, safe place. Such a system is practically a necessity when atomic warfare is considered.

Colonel Clay is liaison officer for the Army Ordnance Department with the Bell Telephone Laboratories.

There are four types of guided missiles which could be considered for either offensive or defensive purposes. These are: (1) ground-to-ground, such as the V-2; (2) ground-to-air, such as an antiaircraft missile; (3) air-to-ground, such as a guided bomb; and (4) air-to-air, such as an aircraft-launched antiaircraft missile.

Supersonic Speeds

It must be assumed that supersonic aircraft will be in existence by the time these missiles are successfully developed. Consequently, such missiles can be successful only if their operating speeds are very high. It therefore follows that they must be powered by jet-propulsion power plants such as pure rocket motors or possibly other types such as the ram jet or aëropulse. Consequently the complete guided missile, as visualized today, would consist of an aërodynamically stable body propelled by a rocket or jet motor, guided by control fins or vanes, and loaded with a suitable war head.

A complete description of all these components is beyond the scope of this article. Comments will therefore be confined to the principal types of power plants and the methods of control which are contemplated for these missiles.

Because of the high operating speeds required for successful application of the various types of guided missiles now under development, the selection of suitable power plants is rather limited. The rocket and the ram jet are the only principal types of power plants available in the near future for use in propelling these missiles at supersonic speeds and consequently only these two types will be discussed.

Rocket Motors

Rocket motors utilizing liquid instead of solid propellants are necessary when we consider motors operating in excess of thirty seconds. In operation, the injection of one or more liquid propellants into a combustion chamber at a controlled rate results in a combustion process which takes place at high temperature and pressure. The expanded gases of combustion are then ejected as a high-velocity stream through a nozzle at the rear of the combustion chamber, thus producing thrust.

The layman commonly believes that the forward motion of the rocket is obtained by the reaction of the jet stream against the atmosphere. However, since a rocket motor will develop thrust in a vacuum this theory is not correct. Actually, the transformation of the heat energy into kinetic energy of flow and pressure causes a force to act in a direction opposite to the flow of the exhaust gases.

Theoretically, the thrust is equal to the mass discharge of the gas stream per unit of time multiplied by the exhaust velocity. The propulsive efficiency (η) may be expressed as follows:

$$\eta = \frac{2\,\frac{V}{V_e}}{1 + \left(\frac{V}{V_e}\right)^2}$$

where V is flight velocity and V_e is the exhaust velocity. It is easily seen that the propulsive efficiency of a rocket motor is highest when the flight velocity is equal to the exhaust velocity ($V/V_e = 1$).

To those who think in terms of the conventional aircraft engine which operates at relatively slow speed, the efficiency of a rocket motor is extremely low. However, if the efficiency curve of the rocket is extended into the supersonic range, the ultimate efficiency obtained is comparable to that of the aircraft engine.

Present rocket motors have exhaust velocities of approximately 5,000 feet a second. Hence, for maximum propulsive efficiency the flight velocity should be around 3,500 miles an hour. Furthermore, all the mass flow originates from the unit itself, and operation outside the earth's atmosphere is not limited by the absence of air.

The rocket motor with its tremendous speed and unlimited altitude is therefore given primary consideration for powering a long-range guided missile. In the present stage of design, however, the fuel consumption of rocket motors is quite high and, as a result, the weight of fuel carried is a high percentage of the total weight of the missile.

Ram Jet

In an effort to reduce fuel consumption, consideration has been given to the development of the other type of power plant mentioned above—the ram jet. The ram jet is a compressorless thermo jet which depends upon the air compression accomplished by the forward motion of the unit for its operation. High-velocity air entering the ram jet is slowed down and its pressure is increased by a diffuser inside the unit. Fuel is sprayed into the air stream and the mixture ignited; the hot expanded products of combustion are then ejected through a nozzle.

By utilizing atmospheric oxygen obtained during flight to support combus-

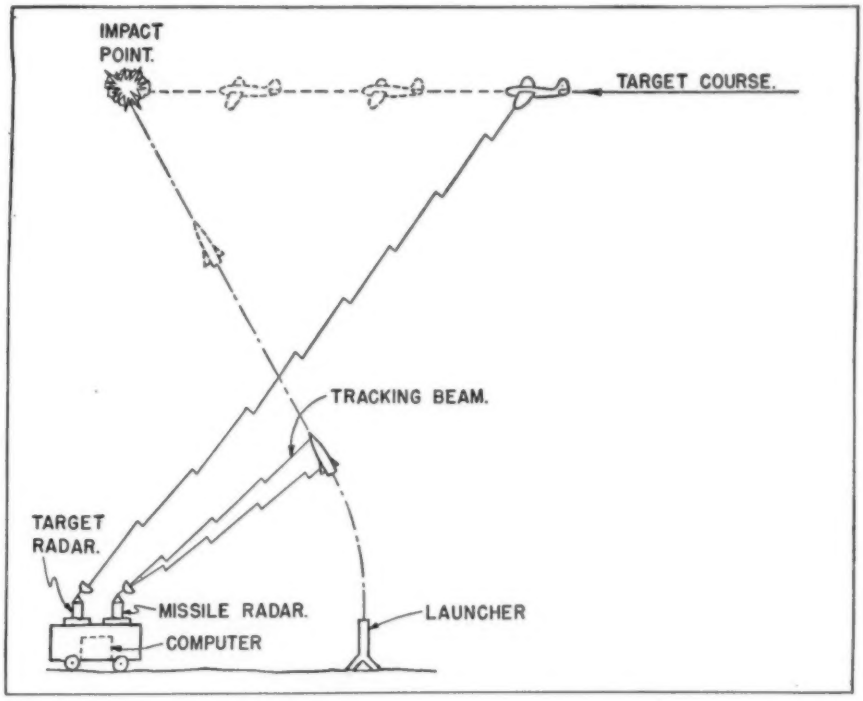


Fig. 1. The command-guidance system uses two radars; one tracks the target while the other tracks the missile which is steered by data from the computer.

tion, the specific fuel consumption of a ram jet is approximately one-sixth that of the rocket. However, the dependence of the ram jet on atmospheric oxygen immediately limits its operating altitude to a maximum of ten or twelve miles.

A further disadvantage lies in the fact that the operation of the unit depends upon forward velocity, and at zero airspeed no useful thrust is obtained. Consequently, a missile employing this type of propulsion must first be launched so that it attains a speed of approximately 700 miles an hour before the ram jet will begin to operate. As far as flight velocity is concerned, ram-jet-propelled devices would probably operate in the vicinity of 2,000 miles an hour.

Perhaps the most difficult problem encountered in the guided-missile program is the development of suitable means of guidance and control. The amount of control to be employed may be varied considerably, ranging from complete control throughout the flight to merely initial control at the launching site. Several basic systems may be used:

Preset Controls.—Perhaps the simplest method of control was employed in missiles such as the German V-1 and V-2 which were guided by autopilots set before launching. In the case of the V-2, gyroscopes were used to actuate the external control fins and the control vanes in the jet stream so that the missile would follow a predetermined trajectory. Fuel cut-off was also accomplished by a gyroscope when the missile reached a velocity sufficient to carry it on a free flight path to the target.

In this system there is no control after launching, and consequently the accuracy depends on the precision with which the gyro sets the speed and angle of pitch. This system is capable of much improvement since its present accuracy is approximately four per cent of the range.

Remote Control by Human Pilot.—The use of remote human control may be employed in several ways for guiding an air-to-ground missile. The simplest application is to provide an operator who can view the missile and the target simultaneously and, by using radio control, guide the missile to the target. This method is obviously limited to daytime employment under good visibility conditions.

The range of the preceding system may be extended considerably by placing a television transmitter in the missile which broadcasts to the human operator what the missile "sees." This modification is still limited to daytime operation and good visibility.

The final step in this system is to use automatic radar control in place of television.

Automatic Homing Control.—Missiles which automatically seek out a target appear practical from the standpoint of engineering problems. Three types of targets capable of being attacked would be those which emitted either heat, light, or radio waves.

In general, however, all missiles with homing types of control are probably limited in range due to the uncertain element of human judgment in target selection.

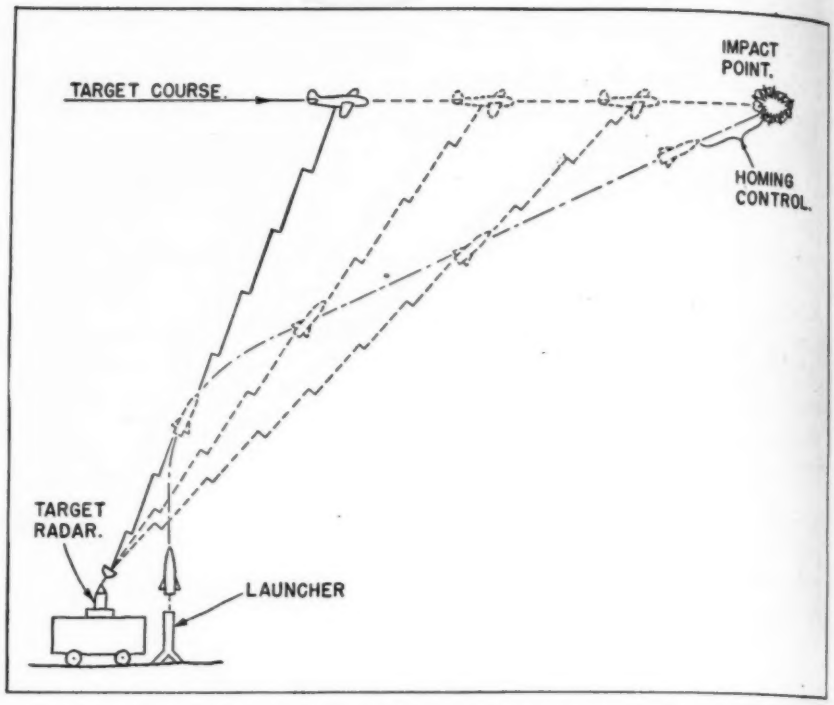


Fig. 2. The beam-rider system employs a radar to track the target and control equipment in the missile which guides it along the radar beam to its goal.

Long-Range Control

The control of long-range missiles becomes extremely complicated by the equipment required both on the ground and in the missile. Several possibilities are available, but many technical and engineering problems must be overcome before they can be successfully applied. Several of the possible systems can be described briefly:

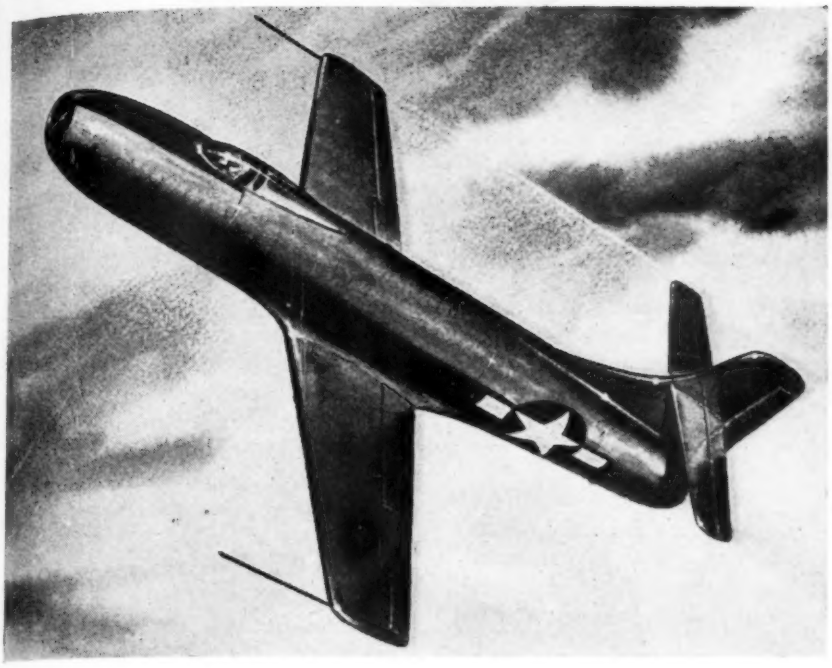
(1) Command Guidance.—This method would employ two radars—one tracking the target and the other tracking the missile—both feeding position data to a computer. The computer would calculate steering orders which would be transmitted to the missile to ensure a collision course even when the target took evasive action (Fig. 1).

(2) Beam Rider.—The beam-rider system would employ a radar set to track the target and control equipment in the missile which would guide the missile along the radar beam (Fig. 2). A homing device would probably be included in the missile to take control at the end of the flight.

The command and beam-riding systems would be applicable in controlling ground-to-air missiles. However, in order to achieve the fire-control accuracy required for destruction of the target, microwave tracking radar sets which operate on the optical line-of-sight principle must be employed, thereby limiting the horizontal range over which control of the missiles can be exercised.

(3) Navigational Systems.—Radio navigational systems must employ long wavelengths in order to send signals around the curvature of the earth, thus immediately limiting the accuracy of such a system. The use of celestial navigation may perhaps be the most practical solution to the problem of long-range control.

It is apparent that we have a long way to go before we can produce an efficient long-range guided missile.



Horizons in Jet Power

New Planning Methods Promise Many Unforeseen Achievements

by

Dr. F. Zwicky

Scientific procedure is needed to integrate effectively the individual technical discoveries produced by men in a free and unregimented society.

BEFORE and during the war, Hitler and his satraps announced secret weapons in the making which would seal the doom of the democracies. The superficial minds among Hitler's adversaries were inclined to discount his prophecies as bluff until it was almost too late. The more thoughtful, however, were apprehensive at all times. They knew that with the great potential of German science and technology behind him, the dictator's ambitions might actually be realized.

How right these more discerning persons were was proved by the findings of the American and British technical representatives in Germany after the war. These findings testify to the ability and perseverance of the German scientists and engineers. A great number of effective devices had been invented and developed in Germany, most impressive among which are the many types of rockets, missiles, and jet planes. These had been brought to a high state of perfection at the end of the war.

Even now, two years after the termination of the hostilities, the scientists and engineers in the United States and in England can point to only a few of their own achievements in the field of jet propulsion which are superior to those of the Germans.

Why Germany Lost

The question may therefore justly be asked why the Germans lost the war. They did so because the Hitler régime lacked the vision and the scentific methods needed to integrate effectively the individual technical achievements. The principal method of organic integration of knowledge is that of morphological planning and consolidation.

Morphological Method

The morphological method is simply an orderly way of looking at things. Instead of getting at detailed and secondary features and thus not seeing the woods for watching the trees, stress is laid first on basic aspects and on a systematic analysis of these aspects. How this method is applied to the particular field of jet propulsion, I shall attempt to demonstrate later.

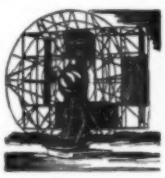
Free men in the past have not always made sufficient and systematic use of their most precious prerogative of morphological planning. The reason for this did not lie in any fear of being thrown into a concentration camp but rather in doubts about the effectiveness of the morphological method and in fear of being ridiculous and unconventional. These inhibitions must be overcome.

To be sure, to apply the method successfully presupposes wide vision and considerable scientific and technical knowledge, and it therefore will be up to qualified men to conceive and to execute large-scale problems on the basis of morphological analysis.

Knowledge of the ways in which such analyses have been successfully executed by others helps in gaining confidence. The following reflections on the history of jet propulsion and on the projected course of future developments are intended to serve this purpose.

Jet Principle Neglected

Through the past centuries and up to 1943 the invention of jet engines and their construction proceeded on haphazard lines. A basic analysis of the problem of propulsive power was never attempted or even conceived. For this reason motors which now emerge as the true representatives of streamlined propulsion were neglected until very recently. These modern motors are based on the systematic application of three fundamental features:



1. The principle of mechanical reaction. More specifically, a so-called positive jet is used; that is, matter is expelled from the propelled vehicle.

Dr. Zwicky is Professor of Astrophysics at the California Institute of Technology in Pasadena and Director of Research at the Aerojet Engineering Corporation in Azusa, Calif.

2. The control of powerful chemical reactions which supply the kinetic energy to the jet which, in turn, propels the vehicle through recoil in the opposite direction.

3. The proper streamlining and ducting of the propellants through the motor and into the jet. If the vehicle is traveling through a substantial medium such as the atmosphere or a body of water, the additional ducting through the engine of this external medium is of extreme importance inasmuch as it makes for so-called thrust augmentation and vastly improves fuel economy.

To be sure, throughout the past centuries the principles just stated were suggested by various inventive minds and were applied to contrivances of all sorts, some of which we shall mention.

The Chinese used chemical reactions and mechanical propulsion through recoil in their firework rockets.

Hero of Alexandria about 100 B.C. devised a steam jet which, through its recoil, activated his aeolipile, a kind of reaction turbine.

Rockets driven by the explosion of gunpowder were used in warfare in Europe since the thirteenth century.

The great Isaac Newton in 1680 experimented with the reaction of a steam jet for the propulsion of rolling land vehicles.

One of the Bernoulli's of mathematics fame seems first to have conceived the idea of propelling watercraft with some sort of hydropulse.

Propulsive Power

It apparently did not occur to any technical philosopher that propulsive power has its own distinct characteristics which clearly distinguish it from stationary power. The idea did not forcefully present itself that the intrinsic kinematical attributes of stationary power are either no macroscopic motion at all, as in an electrolytic generator of electric current, or oscillatory and rotatory motion, characteristic of heat engines and hydroelectric power plants.

On the other hand, the kinematical aspect of propulsive power is translatory motion. As soon as this distinction was recognized a few years ago, the real goal clearly emerged. This goal poses the problem of the direct transformation of chemical or other potential energies into translation, if possible with little or no intervention of oscillatory and rotatory motions.

It seems that most of the basic ideas on propulsive power plants other than pure rockets came from France and Switzerland, while the first practically successful applications of these ideas were made in Germany, England, and Italy. Some of the landmarks in this development are as follows:

Lorin (France) suggested in 1908 the generation of a jet by an internal-combustion engine.

Melot (France) advanced the idea of external thrust augmentation.

Guillaume (Switzerland) proposed a gas-turbine-driven compressor with the exhaust from the turbine constituting the propulsive jet. This proposal was later realized in Germany and in England (Whittle) and resulted in the presently used aëroturbojets.

"Motors which now emerge as the true representatives of streamlined propulsion were neglected until very recently."

The intermittent jet (aëroresonator, pulse jet, buzz-bomb engine) was first developed in Switzerland (Holzwarth at the Brown Boveri Company) in connection with work on self-activated boilers. These first experiments were abandoned in favor of the more efficient Velox boiler.

Flapper valves were also first introduced in Switzerland in connection with superchargers of Diesel engines. Resonating combustion and flapper valves were later used by Paul Schmidt (Munich) and by the Argus factory in Berlin to build the V-1 propulsive power plant (aëroresonator).

Leduc (France) in 1933 conceived the aëroduct (ram jet or athodyd).

Campini (Italy) constructed the first successful thermal jet plane employing a radial combustion engine and centrifugal compressor.

The conventional rocket, as a large-scale propulsive power plant, was first brought to a high state of perfection in Germany (V-2, *Wasserfall,* and other rockets, as well as the engine of the Messerschmidt-163 jet plane).

Morphological Analysis

It is significant that very few basic inventions were made in this country until 1943. In that year, a morphological analysis of propulsive power plants was first carried out by the present author. A similar analysis was started for chemical propellants.

Startling Results

The results were startling. A great number of jet devices of novel design and mode of operation suddenly took shape on the imaginary horizon. Although many of these engines were new, preliminary performance calculations indicated that some showed greater promise than all known propulsive power plants.

A brief outline of the application of the morphological procedure to the problem of propulsive power will be useful in order to visualize the scope of the method.

First, one generalizes any problem which is at hand. For instance, the task may be to design and construct a propulsive power plant which delivers a thrust F for a duration t. In addition, a considerable number of operational and logistic requirements which must be met may be specified.

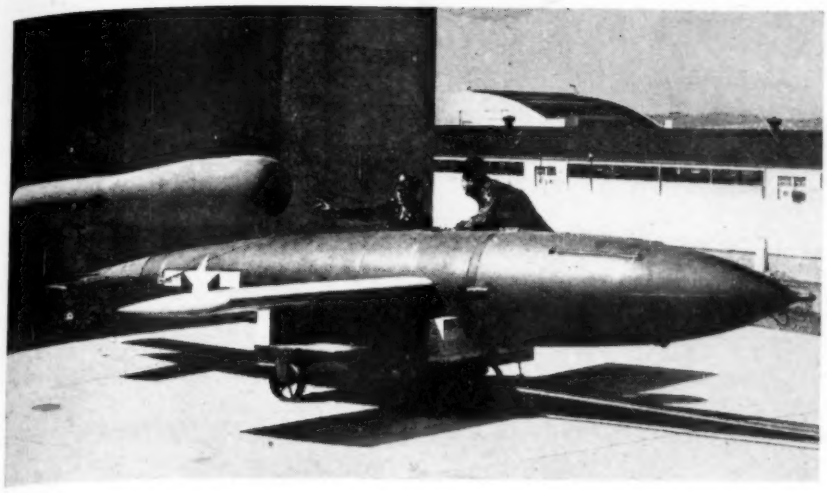
The old-fashioned approach to a problem so formulated is to make a tentative design based on past experience and then to introduce appropriate changes in order to meet all the specifications. This procedure works if the desired propulsive power plant is of a type of which many and varied specimens have been built before. It is not likely to work if little previous experience is at hand.

For instance, if we ask for an engine to drive a vehicle off the earth into interplanetary space and to bring it safely back again, the solution must be sought on a more general basis than changes of conventional designs. This basis is provided by a generic invention of all possible propulsive power plants.

Such invention necessitates *an organized picture of the totality of possible engines,* as well as an evaluation of their performance characteristics. These constitute the second and third steps in the morphological procedure. After these steps have been carried out, one may select the power plant most suitable for the particular requirement.

Specifically, the totality of possible jet engines which are activated through the use of energy from chemical reactions may be deduced as follows:

For the initial review of all possible engines, it is advisable to consider only the *pure-medium engines.* There are essentially four media—vacuum, air,



The JB-2 is the American version of the robot bomb. It is powered by a resonator, or pulse-jet engine, first developed by the Nazis and later improved by U. S. technicians.

water, and earth—through which our vehicles may be propelled. Appropriate propellants must be used to activate the four types of pure-medium engines. These are, respectively, *vacuo-fuels* (or self-contained propellants); *aëro-fuels,* or simply fuels which are burned with the oxygen of the air; *hydro-fuels,* which are water-reactive chemicals; and *terra-fuels,* which are earth-reactive chemicals.

The kinematical aspects of the pure-medium engines include *translation, rotation, oscillation,* or *no motion.* These four possibilities, in combination with the four media mentioned, therefore result in $4 \times 4 = 16$ classes of pure-medium engines.

These classes, however, still contain many types of engines. These types vary, depending on whether the propellants are gaseous, liquid, or solid, or whether external, internal, or no thrust augmentation takes place, and so on.

Altogether one thus arrives at 576 basic pure-medium propulsive power plants. These are advantageously arranged in a 6-dimensional array or a "morphological box." Most of the power plants contained in this box have not yet been built. Some of those showing promise were immediately pursued with gratifying results. Others, like the aëropulse, have not yet come into their own, although this engine, if properly designed, built, and operated, bids fair to outdistance the aëroturbojet.

In addition to the pure-medium engines, there is the group of *interfacial engines* which make partial use of two media, for instance, air and ground, or air and water.

Automobile engines are of the interfacial type, since they use the oxygen of the air to burn the fuel in the engine but push against the earth to transform the available energy into translational power. Similarly, a marine engine uses the air for combustion but achieves its motion through the action of a propeller or paddle wheel on the water.

Finally, there are the *combination engines* which combine features of stationary power plants with those of propulsive power plants and various auxiliaries such as feed systems, etc.

The advice to technical and scientific philosophers is therefore as follows:

1. Assume that the world of possible technical devices is inexhaustible and that even the greatest authorities can visualize only a fraction of them. There is therefore plenty of room for invention.

2. The process of invention is made considerably easier through the application of the morphological analysis. This method automatically brings to light possibilities which otherwise remain hidden for a long time.

3. After a bird's-eye view has been achieved of the totality of the engines contained in the morphological box, a series of approximate performance estimates will point the way to the proper choice of engines for any particular task.

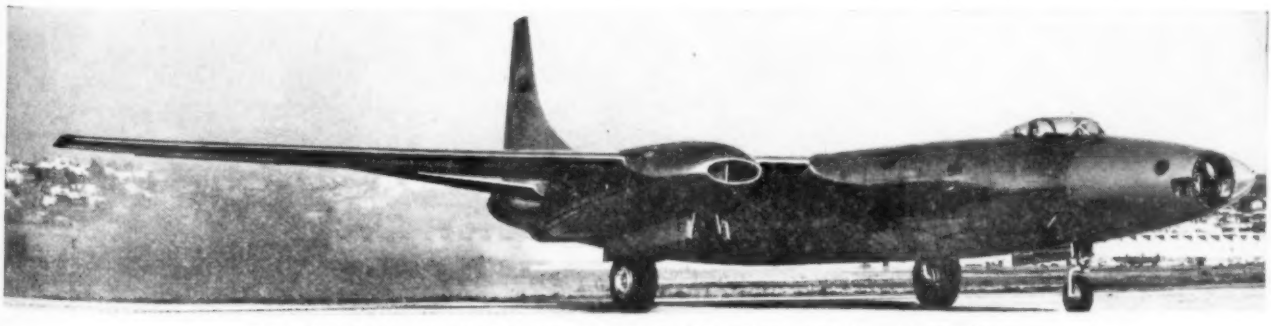
4. After this choice has been made, the engine selected must be designed, built, tested, and put into production. This can be done only through private initiative or by enlistment of government sponsorship.

5. It is a well-known fact that almost every new basic idea or invention will be opposed, ridiculed, or suppressed by professional experts and amateurs alike. The amateurs may, in general, be disregarded. The experts should be listened to but only if they can point out that some fundamental principle of science, such as the law of conservation of energy, the second law of thermodynamics, or the like, nullifies the new idea or invention.

Nuclear Energy

The next major technical problem in the field of locomotion is the application of nuclear energy to propulsive power plants. Those unfamiliar with morphological methods talk about applying nuclear energy to jet engines which were invented for the exploitation of chemical energy. Such an approach will no doubt yield some results, but they are likely to be mediocre.

The true solutions for the interplay of nuclear energy and propulsive power lie elsewhere. They will either be given by men of great genius or by the morphological method in the hands of lesser men who have come to recognize the power of philosophical obstinacy.



The XB-46 jet-propelled bomber has four J-35 engines, two in each nacelle.

Defense for Tomorrow

Industry and Ordnance Must Work Hand In Glove To Make Our Future Secure

by

Col. John J. Breen

"The application of great discoveries to our weapons progress will be, as it has always been, the responsibility of industry."

THERE was a time when the people of the United States knew very little about their Army, and, rightly or wrongly, the Army was accused of avoiding contact with the civilian population. When our War Department initiated the Army Industrial College some years ago, the Army entered a new phase. Previously, the contact between American industry and the United States Army, particularly in peacetime, was tenuous indeed.

Our recent war has demonstrated that not only does the Army belong to the people, it *is* the people. It is now firmly and closely associated with the business and industry of our country.

World War II placed industry in the front rank of national defense. That statement may be literally interpreted, for in these days when war commences without declaration or formality, an enemy bent on conquest will launch the first attack. Recent history has shown the futility of allowing this country to build up its industrial momentum under the guise of neutrality.

We will be the first to be attacked because we have demonstrated our love of peace and its corollary, the lack of a will toward aggression. Unless we can effectively forestall any potential aggressor, we must expect the first blow of any future war to land on concentrations of our industry.

Let us examine the problems which confront us. We want peace. We must find some way to win and preserve this peace. To accomplish this, certain things are required of us right now. First, we must know where our potential enemies are and what their war-making capabilities are. If any nation is considering our conquest it must conceal from us its capabilities and preparations for making war. We must defeat the efforts of any nation to conceal these facts which are vital to our existence: The United States has taken steps to unify the efforts of all Government agencies, not the Army and Navy alone, to procure and keep current the information we need for our protection.

A Mobile Army

Secondly, we must have an armed force capable of moving through the air, over the land and sea, and under the sea. We must have an Army that can move great distances quickly and on short notice. This Army must be able to deposit fighting forces on territory which is vital to an enemy who seeks to attack us. We must be able to deny to such an enemy any territory which could provide launching sites for guided missiles.

In the recent war, England was not saved from the destructive effect of Germany's V-1 and V-2 bombs until the allied ground forces captured the launching sites of these terrible weapons. The margin between success and failure in that one enterprise was too small to give satisfaction.

Thirdly, the United States must foster research and development and must coordinate it in order that we may surpass any other nation in the design and production of new weapons and new methods. The results of pure research are now demonstrated to be of the utmost importance to the liberty of any great nation.

There are individuals in this country who feel that the atom bomb, in combination with the guided missile, can win any war which may be thrust upon us. A cardinal principle of war is "don't underestimate your opponent." Neither must we overestimate our own capabilities. Powerful as the atom bomb is, it does not answer all the requirements for national defense.

In June of last year there occurred a reorganization of the War Department. Instead of the four familiar sections of the General Staff the Department expanded to six staff divisions as follows: Personnel and Administration; Intelligence; Operations and Training; Services, Supply, and Procurement; Planning; and Development.

The first five of these have been present for some time in our General Staff sections. The principal innovation is the raising of development to General Staff level. Prior to the war we had many agencies engaged in research and development. Each branch of our Army, such as the Infantry, the Artillery, and the Cavalry, had its own branch board which tested new equipment and drew up military specifications for new weapons.

This system produced many new weapons used in the recent war such as the M4, M24, and M26 tanks; rockets for use in the air and on the ground; radar, used everywhere; the very high muzzle velocity gun; and self-propulsion for large weapons.

Later Developments

Some of the later developments which came toward the end of the war were kept under wraps. We can see many examples of these in current experiments. For instance, in the field of guided missiles, Ordnance has taken the lead. At White Sands Proving Ground we are firing captured German V-2 rockets and learning much about the flight of such missiles while sharing with science and the other military services the opportunity to learn answers to many basic scientific questions. To date, we have launched a missile to a record height of more than 100 miles into the ionosphere, and greater altitudes will be sought as the V-2 program progresses.

When thinking of guided missiles we must not forget that pilotless planes can be sent thousands of miles. We also read that the Germans were working on plans to send guided missiles across

This article is based on an address delivered by Colonel Breen, Fifth Army Ordnance Officer, before the Quad Cities-Iowa Post of the Army Ordnance Association at Rock Island Arsenal, Rock Island, Ill.

the ocean. No matter how fantastic any new suggestions might appear to be, we should be slow to discount or discredit them.

As a method of approach to any new suggestions, I am reminded of Mr. Kettering's reply when asked for a definition of an incurable disease. His answer in effect was, "An incurable disease is one we haven't found the cure for."

At California Tech we have launched the WAC Corporal rocket, and the Signal Corps has made good use of it as a vehicle for studying weather. Further research is continuing.

At the Aberdeen Proving Ground we have built a wind tunnel for studying the ballistics of bombs and projectiles in streams of air moving at speeds in the supersonic range.

Improved Small Arms

Research continues to improve both the carbine and the already famous M1 rifle, the Garand. Both have been made fully automatic.

Ordnance has developed a caliber .60 machine gun which has a high cyclic rate of fire. In firepower, this weapon is as superior to the caliber .50 as the .50 is to the caliber .30 in size of projectile, range, and flatter trajectory.

Tank design progresses with the thought that we must be prepared to face any contingency. Two of the most outstanding examples of recent tank developments are a 68-ton heavy and a 100-ton superheavy, both armed with 105-mm. guns. Tests are continuing on both.

A new tank transporter will haul away the 100-ton tank, yet it is equipped with ordinary truck tires, like the familiar steam-shovel transporter, and therefore there will be no problem of special tire design procurement.

The ENIAC, a mathematical computer operating by electricity and having 18,000 vacuum tubes, has been completed and installed at Aberdeen. In two weeks it solved one difficult mathematical problem which would have required 100 man-years by hand calculations.

Recoilless rifles, the smallest of which fires an artillery shell from the shoulder with the range and accuracy of an ordinary rifle, have been developed. They are the 57-mm., 75-mm., and the 105-mm. The first two were used in action, and the third is still undergoing tests. The projectile of each one is the same as that for conventional artillery of the same size.

Research and development continues, following the trends indicated by lessons learned in combat. Generally, they show a movement toward lighter equipment and more firepower, not only for the Army as a whole but also for the individual soldier.

Industrial Mobilization

Plans and suggestions for future industrial mobilization in an emergency are now being discussed by the armed services and by the Munitions Board with business leaders and other men of this country. An effort is being made to fit future industrial-mobilization planning into the pattern of normal business as much as possible with the purpose of avoiding interference with peacetime life in so far as this can be done and remain consistent with the national safety.

In accomplishing this mission we must have at our disposal the brains, leadership, and the brawn of our American business and industry. But this is not enough. We can and have designed the most intricate engines of war. To operate these products of American ingenuity we must have an Army superior in intelligence and training.

To prevent war or to prosecute war when it is thrust upon us, this country must have its industry, business leaders, and creative scientists mobilized to provide up-to-date weapons ready for instant use. Our military man power must meet this new requirement. We can no longer expect to train our soldiers in their intricate duties after the emergency has presented itself. We must therefore devise and provide a satisfactory system of training the youth of our land in the basic duties of a soldier. We must find some means of discovering the individual qualifications of our citizens and indexing them for future assignment.

THE objective of any enemy's attack would be to cripple or destroy our industrial capacity before we could even begin to fight a major war.

Those in civilian life and we in the Army have a greater job to do for the national defense than has ever faced the country after any of our major wars. This I believe to be true because at no time in our history have we stood before such vast scientific horizons. The application of great discoveries to our weapons progress will be, as it has always been, the responsibility of American industry, of American education, and of American scientific research in coöperation with the armed forces of our country.

We of the Ordnance Department look especially to our engineering organizations, and particularly to the Army Ordnance Association, to help us chart this course promptly and unerringly so that America will be kept strong.

The Ordnance Department will look to the A.O.A. constantly for counsel and guidance, and our arsenals, our depots, our research institutions, and our proving grounds will be open to A.O.A. members and committees in order that the coöperation begun many years ago may continue to produce results of the highest order.

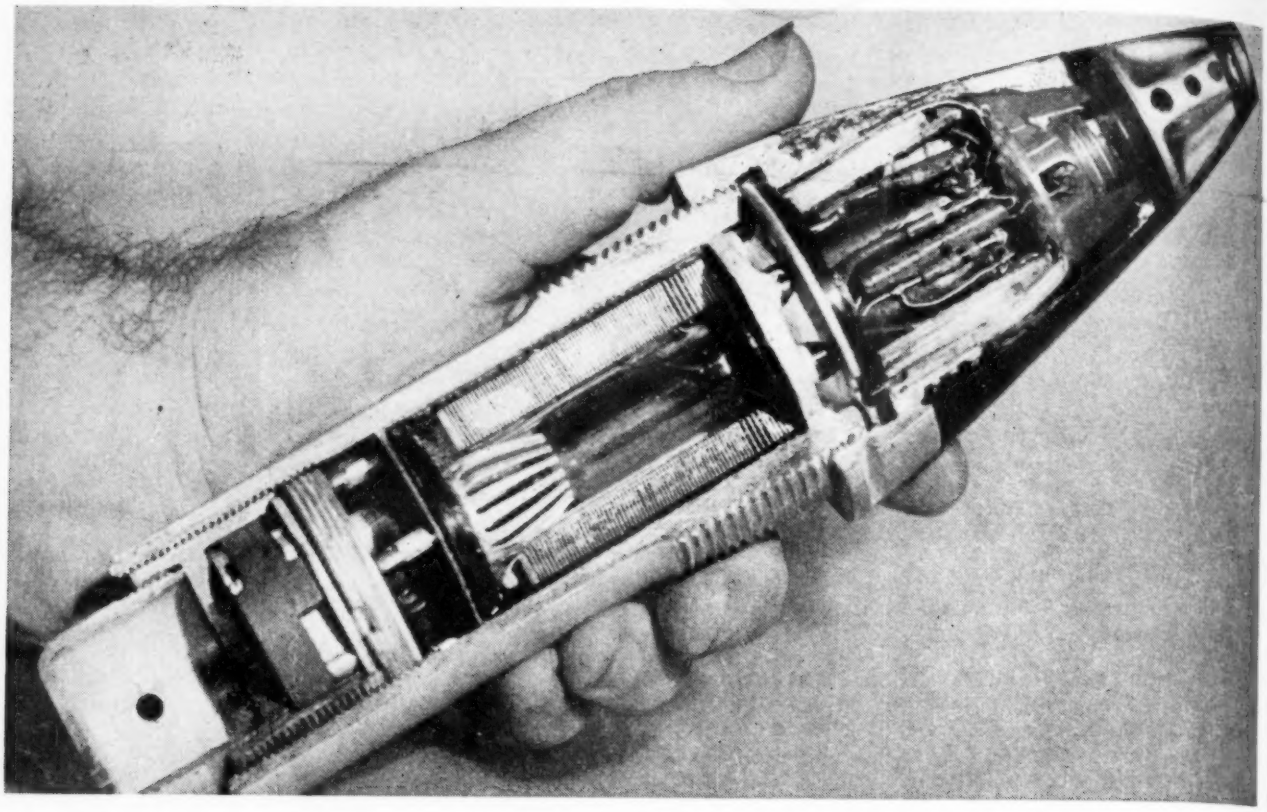
Coöperation Needed

We need have no fear of the future if America remains strong. A most important factor in maintaining that strength is a strong alliance between science, industry, and Ordnance throughout the atomic age.

The Ordnance Department cannot do the job alone; neither can the Army Ordnance Association. No one would expect the manufacturing companies to attempt to do so. The three of us must work together.

A start toward a solution, and one which has been accepted by the Army Ordnance Association, is to organize a total Ordnance Department consisting of officers and men in uniform and executives and men in civilian clothes —these two groups to be tied together on an active, concrete basis. It is planned that each group will be fully cognizant of what the other is doing or can do and that each will maintain contact with the other on a day-to-day, moment-to-moment, realistic basis for true national security.

Our duty is clear. We must all think in one direction. We must keep our goal in mind. We must realize that it is to be one future for all or *no* future for all.



New Weapons—New Tactics

The VT Fuze Has Created Vast Problems of Protection

by

Lieut. Col. F. P. Henderson
U.S.M.C.

"The never-ending quest for more efficient or more deadly weapons and techniques is always paralleled by the search for the proper countermeasure."

AMERICAN science and industry, in conjunction with the Army and Navy, produced two new and revolutionary weapons in World War II—the atomic bomb and the VT fuze. Both have a tremendous potential effect upon the organization and equipment of armed forces and the conduct of future wars.

Colonel Henderson is director of the Marine Field Artillery School at Quantico, Va.

Civilian and military writers have provided us with a rich diet of information and speculation concerning the far-reaching effects of the atomic bomb upon the Nation's armed forces and the civilian economy necessary for their creation and support, but what of the VT fuze?

Since the brief flurry of publicity attending the announcement of the new fuze it seems to have fallen into obscurity, completely overshadowed by the world-wide interest in the more dramatic atomic bomb. Yet the VT fuze poses problems to the military field forces as difficult to solve as does the bomb. Furthermore, the VT fuze is a weapon of today and will be present on the battlefields of the future whether the atom bomb is there or not. It seems logical, therefore, that we should give a high priority to solving some of the difficulties that are already with us, as well as those that will be present in the atomic future.

The never-ending quest for more efficient or more deadly weapons and techniques is always paralleled by the search for the proper countermeasure. One of the oldest and most absorbing of these military feuds has been between artillery and the individual. Whether the individual was a rifleman, a member of a weapon's crew, or attached to some command or service group, the artillery has been his greatest enemy.

Countermeasures

Early in World War I artillery weapons and technique reached a state of development where they could dominate the battlefield. The countermeasures of the individual soldier were ones that changed the nature of war more than any previous developments in military history.

First, he got a shovel and dug a hole in the ground, where he lived and fought, leaving it only when necessary and returning to it at the first warning of danger. For a second countermeasure, he finally abandoned the closed formation that had changed but little from Caesar's day and put space between himself and the next individual.

What had the soldier learned? He learned that if he was below the surface of the ground he was relatively safe

from artillery fire, except for a direct hit. He also learned that when he had to be out in the open in the enemy's sight, a group of men scattered about over a considerable area were much less likely to be fired upon than if they were crowded together. And thus were born the protective field fortifications and deployed formations of modern warfare.

Need for a New Fuze

In order to defeat these measures of self-preservation, the artillery needed only one small item—a fuze that would unfailingly detonate a shell at the optimum height above the target. Such a fuze would nullify the protection of the open foxhole or crew emplacement by spraying shell fragments down into it. It would also take a heavier toll of casualties from a deployed formation than would the percussion-fuzed shell.

The answer was simple to see but solving the problem to obtain the result was difficult. It took us almost thirty years to get the answer finally screwed into the nose of a shell and to learn how tremendously effective it was.

Fortunately, since our recent enemies did not have the VT fuze, we were not under the lash of urgent necessity to find means of protecting against it. Any future enemy will almost certainly have it, however, so that now we are not spared the necessity of examining its effects and providing against them.

What we must provide is complete splinterproof protection against VT fire from artillery, mortars, naval guns, or close-support aviation to all elements of a military force, whether it is defending or attacking. To provide this protection without hampering the mobility of our troops will be one of the most knotty problems that science, industry, and the armed forces will be called upon to solve in the years ahead.

The first and most difficult element to provide for is the infantry, the primary target of most of the shells fired in combat. The rifleman has now been robbed of the protection his foxhole or irregularities in the ground formerly gave him; he is in greater danger than ever before when he moves in the open. Yet he can't be laden with very much splinterproof protection.

As an individual, the best we apparently can do for him now is to develop an ultralightweight body armor (not necessarily metal) that will protect as much of him as the weight limit will allow.

Protecting the Rifleman

As a member of a group, protection for the rifleman seems to lie in the splinterproof troop carrier. In the attack he should be moved to, or into, the enemy's position in such vehicles. This will avoid exposing him in the open to observed artillery and mortar fire, and thereby eliminate the necessity for a further dispersion of troops on foot to avoid excessive casualties.

For the infantry's crew-served weapons such as the mortar, machine gun, recoilless rifles, etc., a lightweight, splinterproof, self-supporting shield large enough to cover the standard open emplacement seems to offer a temporary solution.

The VT fuze has vastly increased the effectiveness of counterbattery fire and makes the conventional gun emplacement obsolete since it no longer offers protection to either crew or gun. The ultimate countermeasure will probably be a self-propelled field artillery mount with complete splinterproof protection for both gun and crew.

Antiaircraft artillery in its deep, revetted emplacements has been relatively safe from air attack. This security vanishes, however, when attacking planes are armed with VT-fuzed bombs and rockets. Complete splinterproof protection, similar to that given naval antiaircraft guns, is now necessary. Light automatic antiaircraft weapons should turn to the self-propelled splinterproof mount.

All command installations must be provided with splinterproof trailers and troop carriers for use when command posts cannot be located in dugouts or splinterproof buildings.

An increased use of engineer troops employing excavating machinery and prefabricated overhead cover is visualized in the construction of a defensive position, even a temporary one. The old hasty defense with its hand-shovel construction, open foxholes and emplacements, no longer offers protection to a defending force. A defensive position, constructed in the presence of the enemy, must be built fast and it must have overhead cover. All engineer equipment operating in the combat zone should have splinterproof cabs and protection for vital parts of machines.

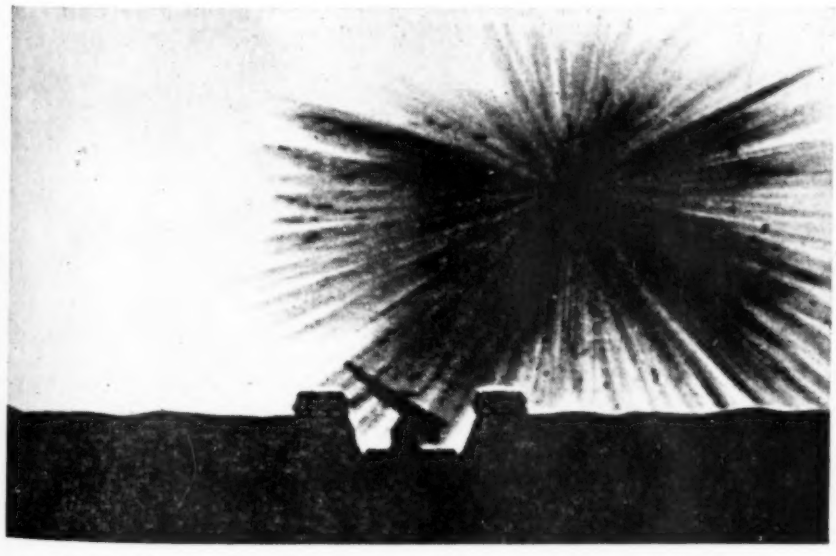
Amphibious and air-borne operations offer special problems in protection. In the former, buoyancy is a critical problem; in the latter, weight and portability. Landing craft for assault troops must have splinterproof protection.

Problem of Logistics

In air-borne operations, the additional weight added to the equipment of a military force by providing splinterproof protection poses a difficult logistic problem as do bulky items such as the splinterproof trailer.

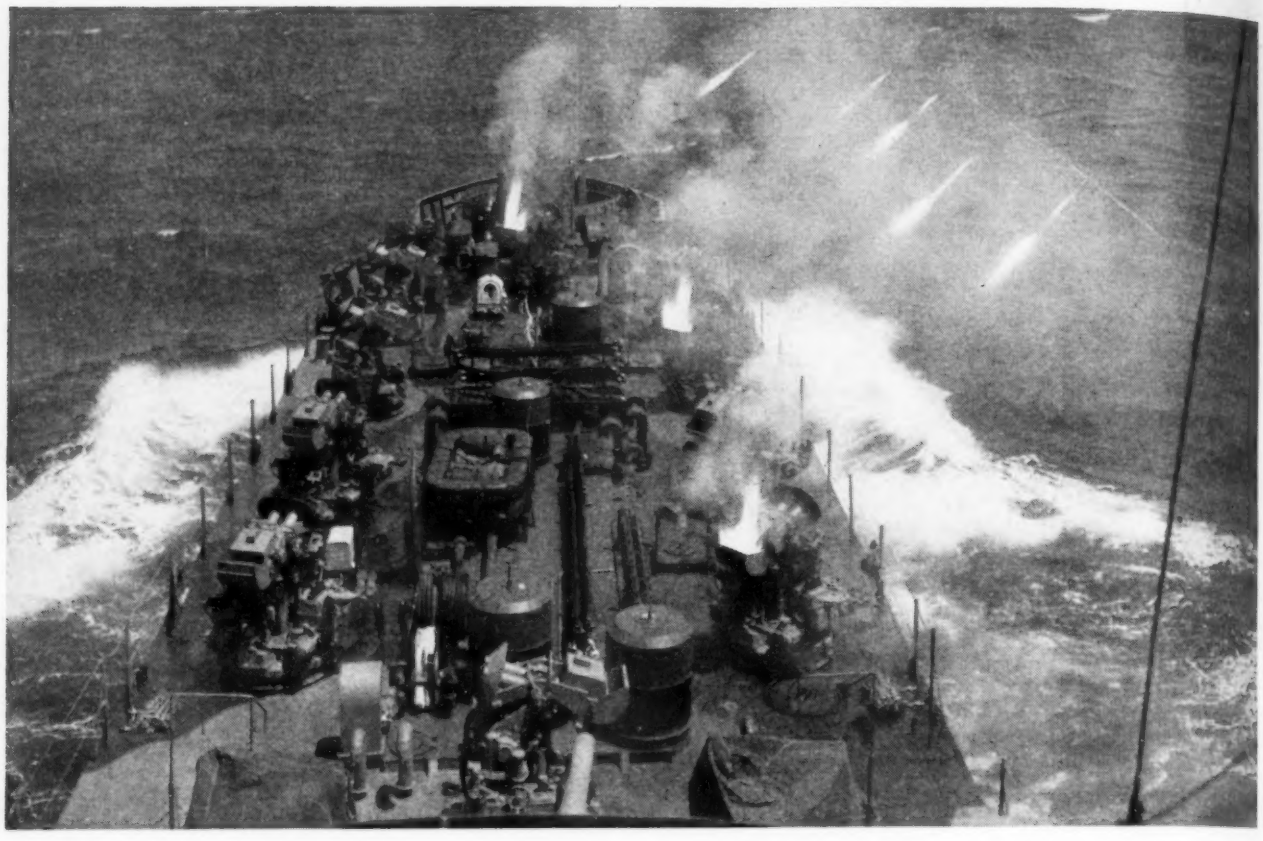
However, only when we are unfailingly able to locate the enemy's weapons rapidly and accurately will we be able to offer secure protection against VT fire to all our troops.

To ensure success of our field forces in the future we must begin now to protect them against VT fire. The atomic bomb, like war gas, may never again appear in combat, but the VT fuze is here to stay.



The VT-fuzed shell makes the conventional gun emplacement obsolete.

New Rocket Power for the Navy



Above is the latest-type LSM(R) with the Navy's modern launchers on its foredeck which can be automatically fired and remotely controlled. Note the absence of exposed ammunition and the neat arrangement of gear. The rocket ship, below, carrying old-type launchers, must be maneuvered to obtain the range and direction of fire while rockets are exposed (Navy photos).

Nazi Rocket Research

Enemy Attempts To Find an Adequate Substitute for Artillery and Bombers

German scientists had an early start in exploring this little-known field.

by
Albert L. Ruiz

"We can truthfully say that the Age of Rockets is here."

ON the evening of September 8, 1944, an explosion rocked the Chiswick section of London. This was not heralded by the familiar wail of the air-raid sirens nor by the peculiar throb of the V-1 pulse-jet motor but occurred without audible warning. This was the first military use of the new German "Victory" or "Vengeance" weapon, the V-2.

From that date, until late afternoon of March 27, 1945, 1,050 of these rockets fell on Great Britain, killing 2,754 people, seriously injuring about 6,500 more, and causing considerable property damage. This was the culmination of 12 to 15 years of German research on rockets, with the expenditure of $300,000,000.

The earliest use of rockets has been attributed to the Chinese. From the thirteenth century onward, there is increasing mention in military literature of the use of rockets for war purposes. The British Navy successfully used them for incendiary attacks on cities and shore installations in the Napoleonic Wars. The British Army paved the way for the capture and burning of the City of Washington in the War of 1812 by the demoralizing employment of rockets against the American defenders.

Despite these successes, emphasis was placed on the improvement of artillery, which gave promise of greater range and accuracy and inflicted greater damage.

Goddard's Experiments

During World War I, Dr. R. H. Goddard, noted American rocket expert, persuaded the United States Army Air Corps to start the development of a rocket for aircraft use, but with the termination of the war the project was dropped. Dr. Goddard, who had been interested in this subject for some time, continued his studies at Clark University during the period between wars and conducted experiments on solid- and liquid-fueled rockets in New Mexico. He is generally credited with some of the basic design features later used by other experimenters here and abroad.

During the 1920's, many experimenters took up rocket work. In Germany there were Opel and Valier and their rocket-driven car which reached a speed of 140 miles an hour; Tieling, who launched rockets which attained an altitude of 5 miles; Oberth, who stated the theoretical principles of the problem in his book, "How To Conquer the Universe"; Nebel, who founded a rocket air field at Reinickendorf near Berlin.

At Reinickendorf, in 1929–1930, there was a student by the name of Werner von Braun, of whom we will hear more later. Work of these various individuals and groups was seriously hampered by lack of cash.

German Efforts

About 1930 the German Army Ordnance Department became interested in rockets. With the restrictions placed on Germany by the Treaty of Versailles, it was felt that rockets might prove to be an acceptable substitute for artillery and enable Germany to keep up with, or perhaps ahead of, her neighbors.

The first attempts were aimed at coordinating the activities of the various groups and arousing the interest of industry in the rocket program. This met with very little success. At that time it became evident that much work was needed on fundamental scientific research in the jet-propulsion field. For these reasons the German Army established, in 1932, a rocket proving ground at Kummersdorf West and gathered the best of the German scientists to work there under the technical direction of W. von Braun.

Intensive work was begun on the fundamental research necessary to provide a firm basis for the development of long-range, liquid-fueled rockets to survey the operational safety required and to construct the first models. In the summer of 1934 the first liquid-fueled rocket of this program, the A-2, was launched. This was a rocket of 650 pounds' thrust, stabilized by a large, direct-connected gyro. It reached a height of 6,500 feet.

The work was proceeding so fast that it became evident that Kummersdorf West was too small. Accordingly, in 1935 a new experimental station was set up at Peenemünde, an island in the Bay of Stettin off the Baltic Sea, where all further work was done. The station was under the coöperative control of the Ordnance Department and the *Luftwaffe*.

In 1938, the next rocket of the series, the A-3, was launched and reached a height of over seven miles. This was

similar to the A-2 but had smaller gyros with servo control of fins in the gas stream. Based on this, plans were made for the A-4, a large rocket with a pay load of one ton and a range of about 200 miles.

It was realized, however, that too big a step could not be taken at once. Hence the A-5, which was to all intents and purposes a small replica of the proposed A-4, was built to test propulsion and control principles for the larger weapon. Many of these were built and flight-tested up to 1942. This rocket had an improved control system similar to that of the A-3 and was somewhat larger, having a thrust of 3,300 pounds lasting 45 seconds.

Chronology of the A-4

World War II began in 1939. The fortunes of the A-4 for the next few years can best be summarized by the following chronology from September 1, 1939, to August 20, 1941:

Sept. 1, 1939—War with Poland begins.
Sept. 5, 1939—Peenemünde declared to be a wartime urgency.
Oct. 5, 1939—Capitulation of Warsaw.
Nov. 13, 1939—Hitler orders the curtailing of Peenemünde.
June 21, 1940—France surrenders.
July 1940—Peenemünde dropped from the priority list.
Autumn 1940—Battle of Britain.
Feb. 1941—Work at Peenemünde receives special priority.
June 22, 1941—War with Russia.
Aug. 20, 1941—Hitler demands greater emphasis on work at Peenemünde.

It is interesting to note how the emphasis on rocket work followed the fortunes of war up and down. In the fall of 1941 Peenemünde received the highest priority—but so had many other projects so Peenemünde still had to wait its turn for materials and men. A budget of 50 million Reichsmarks was submitted, but in spite of the high priority on its work only a miracle could permit the allocation of such an amount, and Peenemünde had to be satisfied with half of what it asked for.

About this time the German Army became hard-pressed for men, and it was difficult for Peenemünde to keep its workers out of the draft. The problem was eventually solved by the army supplying soldiers who worked as civilians. To continue with the chronology:

Feb. 1942—First launching of an A-4 missile a failure.
Mar. 1942—Army High Command loses confidence in possibilities of the A-4.
Apr. 15, 1942—Hitler orders planning for mass production and military use of A-4.
Oct. 3, 1942—First successful launching of an A-4.
Jan. 1943—Constitution of Special Central Committee for expediting A-4 work.
Feb. 1943—Stalingrad recaptured by the Russians.
Feb. 1943—Unlimited financial resources put at Peenemünde's disposal.

Until 1943, the A-4 program had been greatly hampered by the vacillations of a fickle Fuhrer who knew nothing of the technical problems involved. He made his decisions based on the current fortunes of war. He listened to those of his advisers who gave him the best-sounding story, and each of them had his own axe to grind. From this time on, however, the program was backed strongly by Hitler and the High Command, and the work was only hindered by the inability to procure materials. The demands made for mass production of A-4's were far in excess of the country's capacity. It was difficult enough to allocate materials for 5,000 missiles a year, let alone for the 50,000 requested.

But a project of this magnitude could not remain unnoticed indefinitely. In May 1943, the British Intelligence became aware of Peenemünde. Vapor trails had been observed in Sweden, and the cause was soon deduced and the source located.

In the middle of August 1943, a large-scale air raid was launched against Peenemünde. It was reported at the time that the installations had been destroyed and many men had been killed. Be that as it may, the station was in complete operation again in October, and the Germans have since stated that very few of the top men were casualties.

Transition Period

The summer and fall of 1943 marked the transition period between the development and the production of the A-4. It was recognized that this rocket was far from ideal—Von Braun has compared it to the bombing planes of World War I. But the missile was usable, and the state of the war was such that no further time or money could be afforded for major improvements. Germany's mastery of the air had long since gone, and the A-4 was one of the few ways in which she could strike back at England.

Accordingly, the next year was spent in organizing for full-scale production. One factory was to be at Peenemünde with others scattered over the rest of Germany. The program was beset with many difficulties. On the engineering side, 60,000 to 65,000 drawing changes were made during this period. On the material side, plans were constantly being changed because of scarcities. On the personnel side, the man-power shortage was becoming more acute.

In addition, air raids were getting heavier and more frequent. The German armies were continually being pushed back. The immense launching site planned for Cherbourg was captured before it was ever used, and the Russians overran Riga before the factory built there was put into operation. But the program was fanatically carried on. Firings still continued at Peenemünde to work out the bugs, to develop the best operational procedure, and to train Army units to maintain and use the missiles.

When the first A-4, or V-2 as it became known to the people of allied countries, fell on England, it was not a surprise to the military authorities. The first large air raid on Peenemünde was followed during the ensuing year by many more raids. Attacks were made not only on the test station but also on factories and supply-parts plants, such as the famous raid on the ball-bearing plant at Schweinfurt in March 1944.

But it was in June of 1944 that the secret was finally unveiled. Due to a control failure, one of the rockets took an erratic course and burst in the air over Sweden. The Swedes, ever mindful of their "neutrality," insisted that the pieces of this weapon of war be removed from their territory at once, and requested the British to take care of the matter.

From these pieces, the Royal Aircraft Establishment was able to reconstruct the rocket, thereby determining its size, design features, and performance. When whole rockets were captured at the end of the war, this reconstruction was found to be remarkably accurate.

EDITOR'S NOTE.—For information on the American program of testing the V-2 rocket, readers are referred to "Rockets in the Desert" by Lieut. Col. Harvey Rivkins, which appeared in the March-April 1947 issue of ORDNANCE.

Mr. Ruiz is associated with the General Electric Company, Schenectady, N. Y. This article is based on an address given before the American Institute of Electrical Engineers.

The National War College

New Powerhouse of American Grand Strategy

by

Col. William L. McCulla

This institution was established to meet the definite need for understanding and complete knowledge of America's potential capacities in order to make secure the future of our country.

ONE of the most quoted clichés is, "the military is always preparing to fight the last war." The Joint Chiefs of Staff were determined that such would not be the case after World War II. They felt that the study of strategy and the employment of the combined arms was inadequate for their top officers, and that military planning on a national level required the integration of United States foreign policy and military policy.

To this end the Joint Chiefs invited the Department of State to participate in the operation of a college to make available such training for selected officers.

On February 1, 1946, the Secretary of State accepted the invitation, and on July 1, 1946, this highest-level, joint educational institution was formally designated the National War College. It is located in the building which formerly housed the Army War College in Washington, D. C.

Its Mission

The mission assigned the new institution is, first, to prepare selected ground, air, and naval officers for the exercise of command and the performance of joint staff duties in the highest echelons of the armed forces; and, secondly, to promote the development of understanding between high echelons of the armed forces and those other agencies of Government and industry which are an essential part of a national war effort.

Vice Adm. Harry W. Hill, former commander of the Fifth Amphibious Force, who commanded the attack forces in the assault and occupation of Tarawa, Eniwetok, Saipan, Iwo Jima, and Okinawa, was designated commandant of the college, with Maj. Gen. A. M. Gruenther, formerly Gen. Mark Clark's chief of staff in the North African and Italian campaigns, and Brig. Gen. T. H. Landon, former commander of the VII Bomber Command in the Central Pacific, as deputy commandants. George F. Kennan, counselor of the American Embassy in Moscow, was returned to become the deputy for foreign affairs. He has since been designated as chief of the recently organized planning section of the State Department.

"Grand strategy" has been defined as the integration of the policies and power of a nation so that a resort to war is either rendered unnecessary or is undertaken with the maximum chance of victory. This concept may well be considered the principal concern of the National War College.

To arrange a curriculum designed to accomplish the mission assigned was a formidable task, for the several factors which influence national policies—not merely military policy—must be presented in proper perspective without overemphasizing some or depreciating others. This must be accomplished so that the students may acquire a broad background and understanding to be used in studying current problems and in reaching decisions based upon national rather than purely military objectives.

Objects of the Course

The course must develop the close interdependence of foreign and domestic policy, not only with each other but also with military policy. It must, furthermore, demonstrate how military power supports U. S. foreign policy and how and why it must be ready to meet the exigencies of this policy. It must assist in formulating national objectives and pointing out how our military power may be applied to secure them.

Recognizing the magnitude of the

The National War College was established in what was formerly the Army War College buildings situated in Washington, D. C.

task, one of the first steps which Admiral Hill and his deputies took was to outline, in broad strokes, their idea of one approach to the problem and forward this to about fifty outstanding Americans, requesting their comments and suggestions. Often times these took the form of conferences held not only in Washington but at various universities and cities throughout the country. Their comments were not restricted to the subject matter of the course and its presentation. They also recommended individuals to serve on the board of consultants and others, including those civilians who were to become an integral though temporary part of the faculty in order to present certain phases of instruction.

Board of Consultants

The board of consultants was formed under the chairmanship of James P. Baxter, III, president of Williams College and author of "Men Against Time," a chronicle of the wartime activities of the Office of Scientific Research and Development, of which he was official historian.

Other members were Prof. Arnold Wolfers, Yale University; Dr. Calvin B. Hoover, dean of the graduate school, Duke University; Prof. William L. Langer, Harvard University, wartime chief of the Research and Analysis Branch, OSS; and Dr. Walter L. Wright, Princeton, since 1943 chief historian of the War Department.

With the guidance and assistance of this board and others, the commandant and his staff arranged the course with the first term primarily nonmilitary and the second predominantly military in scope. However, in keeping with the mission, neither term was entirely military or nonmilitary, but rather each term was planned to stress the intimate relationship of one aspect to the other and to present, in proper perspective, the factors of grand strategy. The methods of instruction which, in addition to the lecture courses and committee work familiar to all who have attended service schools, incorporated "seminars" that, in general, are more familiar to the graduates of civilian colleges.

For this purpose the class was divided into eight groups of about a dozen officers, each being under the leadership of one of the four civilian members of the faculty. Each student was assigned a subject for individual research and on which he was to prepare a report. As these subjects were all related, they later formed the basis for the solution of a problem assigned to each of the seminars involving many phases of national policy.

In addition to the well-qualified officers of the armed forces who are members of the staff and faculty, outstanding civilians have been integrated to a much greater extent than heretofore in other service schools. Four were prevailed upon to take a leave of absence from their own universities and become full-time members of the faculty for the first semester. They were Prof. Hardy C. Dillard of the University of Virginia, who acted as director of studies, and Drs. Walter L. Wright, Sherman Kent, and Bernard Brodie.

The third source of instruction talent has been the visiting lecturers who were carefully selected not only for their profound knowledge of the assigned subject but also for their demonstrated ability to present it briefly, interestingly, and in a stimulating manner to their audiences.

Regarding the student today at the National War College, the requirements for selection are high and those responsible for making the selections weighed them carefully to ensure that those selected had demonstrated their capacity for positions of great responsibility in various assignments throughout the Government.

The class is composed of thirty officers from each of the armed forces—Army, Navy, and Air Force—and ten Foreign Service officers from the State Department. Several Marine colonels were included in the Navy quota, and the Air Force sent some nonflying officers. Eight of the Air Force officers were brigadier generals while the remainder of those from the armed forces were in the grade of colonel or captain. The Foreign Service officers from the State Department were predominately of grades II to IV.

Members of the different services are distributed among the various seminars and committees to ensure the fullest possible exchange of ideas and opinions, and to expose every one to various methods of working together to find common, acceptable solutions to their mutual problems.

The composition of the committees, including the chairmen, is changed frequently so that each officer will know his classmates well and not merely be acquainted with them. Participation in midday athletics, car pools, and social activities fosters this mutual respect and understanding among the various officers.

The two Ordnance officers in the first class were Cols. William J. Crowe and William L. McCulla. In the present class are Cols. Emerson Cummings and J. H. Hinrichs.

The college's second semester, while predominantly military in character, did not neglect international politics and other phases considered during the fall term but rather integrated them as required in "grand strategy." This part of the course was more nearly an extension and expansion of previous instruction at the Army and Navy War Colleges than the work during the fall term. However, the change was great. There were five main phases in the spring term: current political affairs, science and the armed forces, employment of joint forces, the Military Establishment, and strategy, policy, and planning.

In addition to studying the impact of recent scientific developments and new weapons on the conduct of war, a considerable portion of the time was spent on the problem of how, during a possible future emergency, to best mobilize and utilize the available scientific talent for the over-all good of the Nation.

Consideration of the Military Establishment was more inclusive than the name implies as it also considered the apportionment of effort and resources between the civilian and military for maximum benefit to the country as a whole.

Study of Strategy

The largest amount of time was spent in the study of strategy, policy, and planning on the highest level and included the solution of complex problems involving many conditions and assumptions which have not heretofore been considered by the armed forces and which have never been integrated by any one educational institution.

Colonel McCulla is the chief of the Small Arms Branch, Ordnance Industrial Division. He was among the first students to graduate from the newly established National War College at Washington.

THE TRANSPORTATION CORPS

One of the youngest organizations in our Army, the Transportation Corps from its inception was faced with the most prodigious transportation job in history, and its outstanding achievements in accomplishing this mission have already given birth to a new tradition and legend.

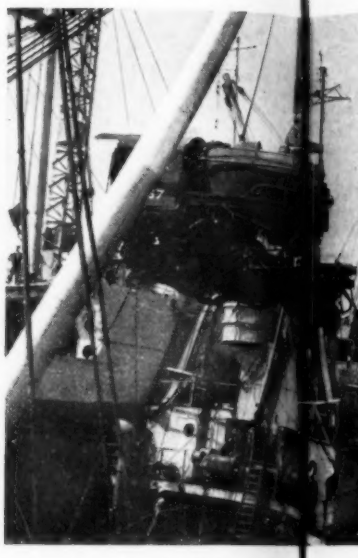
It is literally impossible to contemplate the magnitude of the task of moving our armed forces and all the needed war supplies both here and abroad. For instance, in the zone of interior, over ten million men and women were transported to induction stations, reception centers, and training camps. More than seven million people were transported by the Army from the U. S. to overseas theaters of war between December 1941 and August 1945.

The difficulties which the Transportation Corps encountered as a result of the war were great, and the manner of overcoming them was truly remarkable.

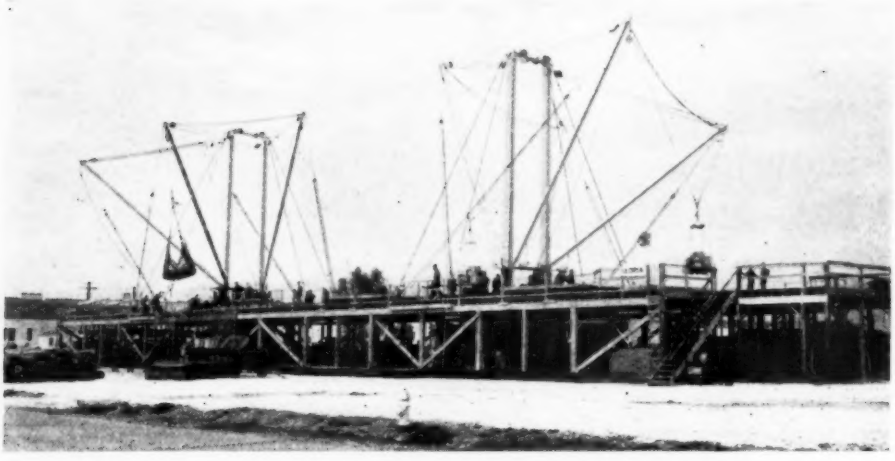
Something of that story is told here so that the lessons the Corps learned the hard way may contribute to our national security in the unrestful and uncertain future.

Long trains like this, hauled by giant locomotives, under the control of the Transportation Corps, carried the munitions of wa untry fr

An Indian elephant served the Military Railway Service very well as a switching engine at a railhead in Assam, India.



An American-built locomotive is onto a d



This dry-land ship was designed to teach cargo-handling and loading-machinery techniques.

This jeep, can pu

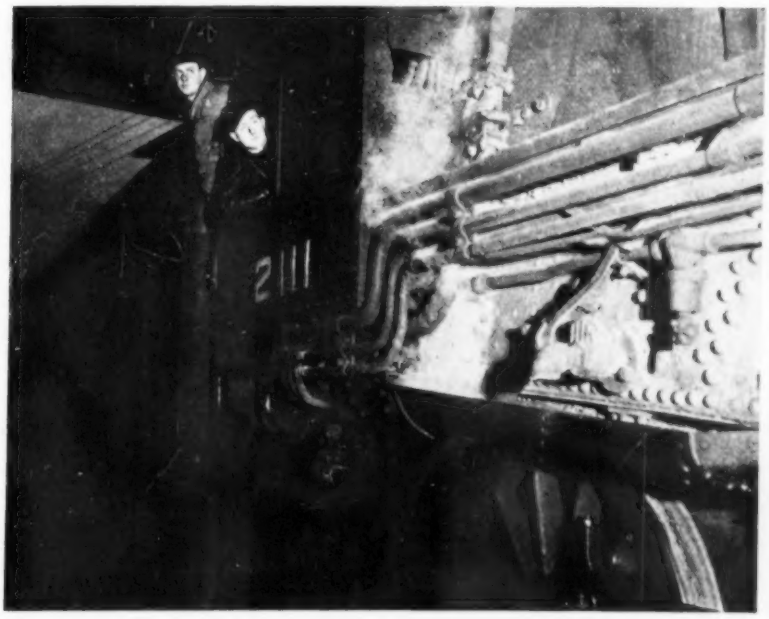
ns of wa untry from factories to seaports.

otive i onto a dock in Cherbourg.

p, co can pull three loaded freight cars.

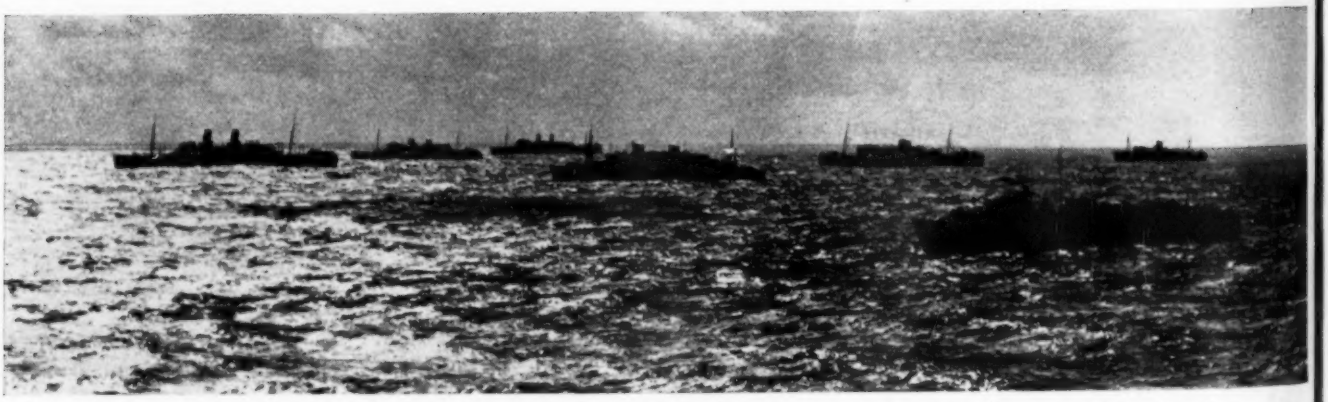
Amphibious trucks did yeoman service for the TC in unloading ships lying offshore and bringing cargoes directly to supply dumps.

Civilian personnel were used wherever practical. Here a French engineer operates an Army locomotive under American supervision.



Modified LST's fitted with tracks were known as sea-trains and could carry railroad cars to beachheads where they could be rolled directly ashore onto near-by rail lines.

Above, ships were loaded and unloaded overseas by port battalions that performed tasks that were herculean. The air-sea rescue craft, left, was used to train Transportation Corps personnel.



The steady march of convoys around the world carried the supplies that overwhelmed our enemies and brought victory.

The Ordnance Department Board

For Better Service to All Army Components

by

Col. Harry N. Rising

"The need for constant improvement in Ordnance service to the Army is a never-ending story."

THE Ordnance Department Board devotes its full time and energy to determining ways and means by which the Ordnance Department may render better service to all of the components of the Army which it supports both in war and in peace. Recommedations believed to be necessary for the improvement of Ordnance service are submitted to the Chief of Ordnance.

It should be kept in mind that the board is in no way concerned with research, development, or test of any item of matériel produced or procured by the Ordnance Department for the common user. There is, however, a limited but important field for the board to explore.

This field can best and briefly be described as "Ordnance service" and includes analysis and summation of the reports on consumption of ammunition, major items, and spare parts in the several theaters during World War II; the review and improvement of all Ordnance publications; and the study and survey of ways and means for Ordnance troops to use their normal or improved equipment better in order to accomplish their missions.

The need for constant improvement in Ordnance service is a never-ending story. The problems encountered during the recent war of providing Ordnance service to all the arms throughout the world and in every type of climate indicated the need for Ordnance equipment that would be capable of satisfactory operation in extremes of temperature and humidity.

Substitutes Improvised

To satisfy unusual conditions, Ordnance troops often found it necessary to use expedients in the modification of standard ordnance items and to improvise substitutes where necessary. These expedients in some cases involved major rebuilding in order to assure the adaptability of the item to special conditions.

The vast experience in field service gained by Ordnance officers throughout the world is being collected, collated, and made available to the Ordnance Department by the Ordnance Department Board.

Saving Man-Hours

As a result of the initiation of questionnaires to experienced Ordnance officers, many varied approaches have been made to the understanding of the special problems that confronted these officers and the solutions they made in the field. Evaluation of the standard items of Ordnance tools and equipment employed during the war indicates that a considerable field has been uncovered where a resultant saving in man-hours and in money can be effected by using improved modern tools and new developments in industry.

One direct result of overseas Ordnance service during the war has been the improvement in Ordnance supply and in maintenance operations and procedures. Methods and techniques employed to render timely service in isolated combat areas, far removed from the normal conditions encountered in the zone of the interior, have made it necessary for some elements of such Ordnance service to be simplified and highly flexible. It has been ascertained that many of the stock control methods that worked smoothly in the United States were believed to be too cumbersome for detailed use in an overseas installation where time and man power were at a premium.

The Ordnance Department Board is

Colonel Rising, the commanding officer of Watervliet Arsenal, N. Y., was formerly president of the Ordnance Department Board, Aberdeen Proving Ground, Md.

currently analyzing such overseas operations in order to extract the more worth-while means and techniques which were so ably applied to improve the service rendered throughout the overseas communication zones and army areas.

A constant review of comments from the field is conducted at the Ordnance Department Board in order to make certain that all data are compiled and catalogued in such a manner that the more outstanding results of improved wartime Ordnance service are made available.

Transportable Ordnance

With the current prospect of a highly mobile type of warfare in the future, and the operation of many small units widely dispersed from the parent fighting force, it has become more apparent that all items of Ordnance maintenance must be readily transportable by land and by air. With the prospect for the various components of the arms and services being widely separated prior to contact with the enemy and only concentrating immediately prior to battle, improvements that accomplish weight reduction of ordnance items are continuously sought.

Organizational, field, and base maintenance operations assume a new aspect in the light of such wide dispersion of units with the possibility that the trend toward evacuation of major items of ordnance rather than field repair may become the standard operations procedure for all Ordnance service.

It may thus be recognized that the questions raised by such a drastic revision of current standard practices will necessarily change the structure of the Ordnance organizations that render the various types of Ordnance service in an active theater of operations.

One of the postwar missions of the Army Ground Forces is the revision of many tables of organization of the various components of the Army. This action has necessitated a complete review of the corresponding Ordnance organizations that accompany or support these forces in the field. In addition to the insertion of many new items of tools and equipment resulting not only from the development of expedients during the war but also from progressive industrial improvements in the design and quality of tools and equipment, there exists a requirement for an over-all analysis of the personnel requirements of all Ordnance organizations.

The Ordnance Department Board does not enter into the field of pure design and research of items of equipment used by arms and services other than Ordnance. The board definitely *does* consider the necessity for improvement and supplement of items of equipment used exclusively by Ordnance troops in the field. This is a matter of prime consideration by the board. Studies of work efficiency that is produced by an item of equipment is used as a direct measure in the worth of such equipment to Ordnance troops in the field.

With the altering needs of Ordnance service resulting from the changing tactical field organizations of the Army, modifications in the military characteristics and specifications of all types of Ordnance service items are essential.

It is recognized that outmoded tools and equipment must be replaced by improved models which will remove the limitations imposed by the meager field facilities that may be envisioned in any future theater of operations. With this principle in view, active liaison is maintained with appropriate field organizations on the one hand and with the research and development organizations responsible for the procurement of ordnance on the other.

Observation and Study

Observation and study of the actual application of equipment recommended for standardization and issue is supervised by the board. A practical service test is made by the utilization of troops within a technical service unit that is a part of the board's immediate resources or by actual placement of such equipment in the hands of troops of the armed forces.

It may be noted that in the conduct of a specific project designed to enhance the service rendered to a field organization, concise and complete information concerning the actual use to which the item is placed in the field is obtained from all interested agencies. In this consideration, changing trends of tactical developments of every size and category of units of the Army are considered in order to ensure that no contingency is overlooked in the actual use of the item under general and specific field conditions. A major objective in this analysis is adherence to the principle of extreme mobility.

The Ordnance Department Board is placing emphasis upon the review of all Ordnance doctrine relative to the employment of publications by Ordnance field organizations. The object will be over-all simplification not only in format but also in the number of such publications that need be carried by an organization which performs a given field mission.

Comments from field commanders have stressed the need of adequate technical manuals which include all data needed for the proper servicing and maintenance of ordnance. But the same commanders believe that much of the catalogue material they receive in active organizations is superfluous.

The Projects Division

The principal operating section of the Ordnance Department Board is the Projects Division. The chief of this division uses the services of associate members who are junior officers with varied specialized experience. These project officers collect information and conduct tests that provide material for reports upon assigned subjects.

In addition to the general Ordnance service functions already described, the Ordnance Department Board is separately charged with several phases of bomb-disposal activities. Consequently, a Bomb Disposal Division is incorporated in the structure of the board.

The activities for which the Bomb Disposal Division is responsible include: (1) Collection, evaluation, and dissemination of information on the disposal of explosive munitions; (2) The development of disposal methods and special equipment for handling all explosive items; (3) Procurement, preservation, storage, and issue of all special bomb-disposal equipment; (4) Editing and preparation of information on bomb-disposal activities; (5) Revision of bomb-disposal manuals; and (6) Field operations in connection with special bomb-disposal problems for the Office of the Chief of Ordnance.

The Ordnance Department Board is quartered with the Ordnance School at Aberdeen Proving Ground, Md. The board occupies the second floor in the east wing of the building which is shown in the accompanying illustration.

Atomic Research Center

Brookhaven Laboratory Will Unlock Many Nuclear Secrets

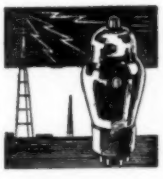
Associated Universities, Inc., which will operate the Brookhaven National Laboratory, is a nonprofit corporation formed by nine major eastern universities. Other universities, as well as private and public institutions, will also participate in the research planning and the use of the research facilities. The nine member universities are: Columbia, Cornell, Harvard, Johns Hopkins, Massachusetts Institute of Technology, the University of Pennsylvania, Princeton, the University of Rochester, and Yale.

BROOKHAVEN National Laboratory for atomic research, a Government-owned, government-financed project operated by Associated Universities, Inc., under contract with the United States Atomic Energy Commission, is under construction on the 6,000-acre site of Camp Upton, Long Island, N. Y.

The laboratory will provide to universities, industries, and other research organizations in the New England and Middle Atlantic states a training and research center for the investigation of atomic energy. It will be equipped with facilities beyond the reach of individual institutions.

Trustees of Associated Universities, Inc., and officers of the laboratory expect it ultimately to have a permanent scientific staff of 300, a visiting staff from coöperating institutions of 200 or more, 500 laboratory technicians, and administrative, service, and maintenance personnel numbering about 1,000. Some one hundred scientists will have been assigned by fall of 1947. Scientific activities, including the design of the atomic pile and other large equipment, are already under way, under the direction of Dr. Philip M. Morse, director.

The research program of the laboratory will be directed primarily to the development of new fundamental scientific information on the nature and properties of atomic energy and other applications of atomic techniques to physics, chemistry, biology, and medicine. From such research will come a better understanding of atomic energy and nuclear reactions, of methods for controlling disease and animal and vegetable life, improvement of materials and techniques for producing atomic power and preparing radioactive isotopes—the variant forms of an element differing only in atomic weight.



The Brookhaven National Laboratory will provide facilities for basic research in the physical, chemical, biological, medical, and engineering aspects of atomic science and for the training of scientific workers in these fields.

Present plans call for the construction of a graphite-uranium pile and an associated "hot" laboratory where radioactive isotopes may be separated. A second pile with one hundred times the neutron flux of the first is also planned.

Other projected facilities, the designs of which are major research problems in themselves, will include a 30- to 40-million electron volt cyclotron; an electronuclear machine capable of accelerating either electrons or positive particles (possibly both) to energies of a billion volts; a 600- to 1000-million electron volt synchrocyclotron; possibly a 10- to 20-million volt Van de Graaf (electrostatic) generator; and diverse apparatus and instruments for use in research with these machines and their products.

The laboratory's two nuclear reactors (or chain-reacting atomic piles), one of low and one of high intensity, will be an integral part of the research equipment. Radioactive substances prepared in these piles will be used primarily at Brookhaven for the research program.

The first reactor will be a graphite-uranium pile. Of simple and flexible design, it will provide research facilities during the period of experimentation and development necessary before the high-intensity machine can be constructed. It will have continuing usefulness for work not requiring the maximum possible flux. Initial operation is expected to begin in 1948.

The special "hot" laboratory will be used for the chemical purification of radioactive substances prepared in the pile. It will be part of the first reactor program.

Research work which can be conducted with this initial reactor will include: (1) Preparation of radioactive substances to be used as the basis for programs in chemistry, physics, biology, and medicine; (2) Study of the nature of atomic nuclei through investigation of the nature of the neutron and its interaction with matter; (3) Determination of the limitations in the industrial production of atomic power through investigation of changes produced in metals and other structural materials when placed within the pile; (4) Exploration of medical uses of neutrons and the use of neutron beams to explore the structure of metals.

Design of a second reactor with a neutron flow and power density hundreds of times greater than that of the first will begin at once. This high-intensity pile will incorporate facilities for investigation of the fundamental engineering problems involved in power production and in the preparation of fissionable as well as other special isotopes.

A 60-inch cyclotron which will accelerate particles to 30 million electron volts will be used for the preparation of those radioactive isotopes which cannot be produced with a nuclear reactor.

Many research problems depend upon the use of highly radioactive materials in concentrated form which cannot be produced in an atomic pile. The 60-inch cyclotron will more than double the number of isotopes available for use and study at the laboratory.

In addition to this "small" machine, which is now practically standard equipment for most large atomic laboratories, design research has already begun on one or more machines which will equal any now existing or under construction.

The Soper Rifle

Sixty Rounds a Minute in 1870

by

S. Basil Haw

Private collector and student of antique arms, Sidcup, Kent, England.

Twenty-four hours probably made the difference between fame and obscurity for this outstanding old weapon.

PROMINENT among those who greeted with great disfavor the adoption of the Martini-Henry rifle by the British services in April 1871 was William Soper, a gunmaker of Reading, Berkshire. He had submitted a breechloader of his own design for the trials of 1866, only to have it rejected on certain technical grounds. Profiting by this experience, he had set to work to redesign and modify his rifle and had a specimen ready for the trials of 1868. Unfortunately, owing to some unrecorded oversight, he submitted the new model one day beyond the time limit set down, and it was accordingly debarred from the trials. It is with this second model principally that the following notes will deal.

Very little information is available regarding William Soper himself. His name first appears in the Reading directory as a gunmaker in 1867 and vanishes from it in 1884, his firm being located at 23 Friar Street during the whole of the period.

He makes his first appearance in the records of the British Patent Office with Patent No. 2151 of 1865, granted to him for a form of breechloading mechanism which could be modified to take either pin-fire shotgun or center-fire rifle cartridges.

This mechanism was based on the use of a vertically sliding breechblock of more or less orthodox design which was operated by a form of under lever. It embodied a rather curious type of hammer which operated upward and which was completely enclosed in the body of the mechanism under the chamber of the barrel, being cocked simultaneously with the opening of the breech by means of a connecting link attached to the operating lever.

The writer thus far has never encountered a specimen of this particular design in manufactured form. Nor, up to the time of writing, is he able to state whether the rifle which Soper submitted to the trials of 1866 was constructed on this principle or not.

It is conceivable, however, that the latter was based on his original design (or a variation), since there is a gap of more than three years between his first patent and the one covering his second and far better known rifle (No. 3637 of 1868).

The model which Soper had intended to enter for the trials of 1868 was fitted with a breech mechanism radically different from that of his original patent, though there are superficial points of resemblance between certain details of the lock mechanism, etc., of both arms. It belonged to the relatively widespread class of weapon whose breech was closed by means of a laterally swinging block. In the case of the Soper, the receiver consisted of a trough-shaped shoe on to which the breech end of the barrel was threaded.

The Breechblock

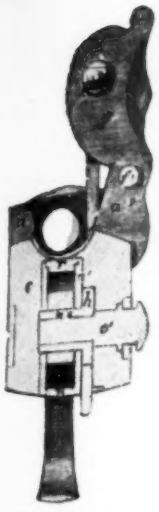
The breechblock itself—considerably shorter than that of the Snider—was pivoted on a stout pin running through two abutments on the right-hand side of the shoe, a projection on its opposite side resting securely between two corresponding abutments on the left-hand side of the shoe. The general outlines of breechblock and shoe bear, incidentally, a rather remarkable resemblance to those of the Cornish rifle of 1866.

An ordinary military nipple was screwed into the rear face of the breechblock in line with the axis of the bore. An advantage claimed for the use of this nipple was that it could be covered by the regulation "snap cap" for practice purposes. Through it passed a freely floating firing pin on which was turned a small collar which (at the retracted position of the firing pin) rested against the front face of the nipple.

This device—on which Soper laid some stress—was designed to obviate the escape of gas from a faulty cap blowing back along the line of the firing pin by causing the collar to set back against the front face of the nipple.

The breech and lock action of the Soper rifle were comprised of twenty-

The action of the Soper rifle, showing the swinging breechblock with nipple, the hammer at full cock protruding from its recess, and the operating lever.



The breech open.

three parts, of which only two were springs. The employment of the regulation Enfield V-type mainspring and the absence of spiral springs throughout the entire mechanism received the favorable comment of many contemporary experts—prejudice against spiral springs being somewhat strong in those days. The entire mechanism was both simple and sturdy. It was quite impossible to fire the cartridge unless the breechblock was locked securely home.

As already noted, the Soper was excluded from the Government trials of 1868, but an article which appeared in the journal, *Engineering* (January 13, 1871) states that it had passed successfully the "sand test" at the Wimbledon Volunteer Meeting of 1870 and had also been tested privately under conditions precisely similar to those employed by the Select Committee. This is further confirmed in Greener's "Modern Breechloaders" (1871), in which it is stated:

"Experiments have been made to test the strength of the breech arrangements, in which, on several occasions, 200 grains of powder and a plug of lead 530 grains in weight have been fired. Full service cartridges have also been fired, having the base cut open with a saw so that the gas has had a free passage into the breech chamber, without in any way interfering with the action of the working parts. It was also severely tried by placing it under water for a fortnight and then leaving it for the next fortnight exposed to the action of the weather in the open air during the month of November, when, without oiling or cleaning in any way, it was repeatedly fired without miss or hitch of any kind occurring, the same rifle having previously successfully passed through the ordinary sand test, as used by the Select Committee at Woolwich."

Soper was a member of the 1st Berkshire Volunteers (holding the rank of sergeant) and, owing obviously to his direct influence, his rifle was adopted at a relatively early stage in its career by that unit for use in the competitions at the old Wimbledon Volunteer Meetings. Of its performance on these occasions a certain amount of record exists, which brings particularly to the fore its main characteristic—the extraordinary rate at which it could be fired.

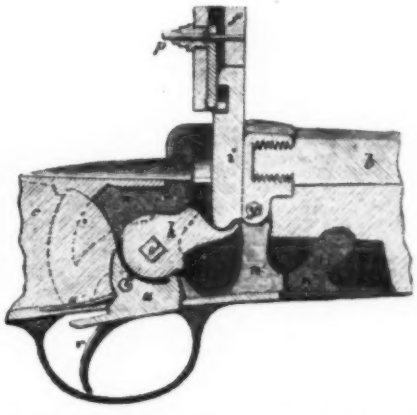
An outstanding member of the Berkshires' squad was a certain Private Warwick, whose feats of rapid fire with the Soper rifle earned for him what the *Berkshire Chronicle* of July 29, 1871, described as the sobriquet of the "Berkshire Mitrailleuse."

Soper exhibited his rifle at the Basingstoke Exhibition of 1870 and there—according to a report which appeared in *The Field* (April 16, 1870)—a demonstration of it was made by Warwick under the supervision of Wyndham Spencer Portal, Esq., with Major Grimstone, R.A., acting as timekeeper, in which it was loaded and fired *sixty times in one minute.* The correspondent added that the same rate had again been attained in another demonstration in his own presence.

A Remarkable Show

The Soper rifle, in the hands of the 1st Berkshire's squad, put up a remarkable show at the Wimbledon Meetings of 1870, 1871, and 1872. It literally swept all before it in the rapid-fire competitions and, in addition, showed itself to be a weapon of excellent accuracy. Contemporary newspapers commented most favorably on its performance—the London *Standard* remarking that "there is a strong feeling that justice has not been done to the Soper rifle, and an experiment which was made yesterday entirely tends to show that this weapon has exceeding merits."

It is very evident that Soper was thoroughly aggrieved by the treatment which he had received at the Government's hands in 1868. He had the utmost confidence in the qualities of his invention and, being obviously a man of energy and determination, set out to bring his case as much as possible before the public eye.



Side view of action showing connecting rod (*i*), nipple (*p*), and the operating-lever safety (*u*).

Publicity

Not content with the publicity which he had received from the excellent performance of his rifle at the Wimbledon Meetings and the favorable articles on it which appeared in various technical journals, he broadcast a pamphlet of his own composition.

As a preliminary to this, he circularized seven engineers of repute (mainly connected with the chief railroads of the day) and thirteen leading firms of London gunsmiths with a questionnaire. This consisted of thirteen queries, the first of which was the prudent one: "Are you personally interested, pecuniarily or otherwise, in the success of the Martini or the Soper rifle?" The remaining twelve queries dealt with various technical and mechanical points on which a comparison between the two rifles was invited.

The replies were overwhelmingly in favor of his rifle, and he accordingly published them in tabular form in his pamphlet, together with a variety of quotations from contemporary press reports, etc.

But all his efforts were fruitless, and his rifle was never adopted for any of the British services. The article in *Engineering* (1871), quoted earlier, states that "the inventor is constantly engaged in filling orders for the rifle in its newest and most modified form" and it certainly enjoyed a modest reputation in sporting form, though the demand was never sufficient to encourage him to launch out into large-scale production.

One can sympathize with Soper who was, after all, only one of the innumerable victims of that craze for red-tape methods which so often besets the official mind. After this lapse of time, it is interesting to speculate whether his rifle *would* have been adopted in place of the Martini-Henry had it been permitted to take part in the trials of 1868.

Viewed dispassionately, it seems likely that it would have had a very good chance of success.

(Illustrations are from the January 13, 1871, issue of *Engineering*.)

For Eminent Service We Salute These Industry-Ordnance Leaders

Col. Philip Schwartz

Chester H. Lang

Lieut. Col. Ralph C. Scott

D. Luke Hopkins

Lieut. Col. C. J. Williams

Col. Philip Schwartz is Ordnance Officer of the Strategic Air Command, United States Air Force. He has had a long and distinguished career in aviation ordnance. During World War II he was Ordnance Officer of the Third Air Force and of the Eighth Air Force in England, and Chief Ordnance Officer and director of armament of the United States Air Forces in the European Theater. He was one of the founders of the Los Angeles Post, A.O.A.

Chester H. Lang is a director of the Empire Post, A.O.A., and a vice-president of the General Electric Company at Schenectady. Well known in civic affairs, he became chairman of G.E.'s Defense Coördinating Committee, later the War Projects Committee, to coordinate the many varied activities of that great company in World War II.

Lieut. Col. Ralph Cook Scott of San Francisco, Calif., has served with distinction both the Ordnance Department of the Army and the Army Ordnance Association. He is the founding father of the Los Angeles Post. In World War II he commanded the Umatilla and Black Hills Ordnance Depots and the Green River Ordnance Plant, Dixon, Ill.

D. Luke Hopkins, a banker of Baltimore, Md., managed the Applied Physics Laboratory of the Johns Hopkins University where the development of the VT fuze was carried to successful conclusion.

Lieut. Col. Carroll J. Williams, Rock Island Arsenal, Ill., served as assistant Ordnance officer of the V Army Corps in Europe for more than three years. He is presently engaged in plant engineering activities at Rock Island Arsenal.

Col. James S. Crawford, U.S.A., Retired, is president of the Yankee Post, A.O.A., and former chief of the Boston Ordnance District. His outstanding Ordnance career is measured by the deep admiration of his many friends in the Ordnance fraternity. During World War II he was commanding officer, Iowa Ordnance Plant, and Ordnance Officer, New York Port of Embarkation. He is now vice-president in charge of production, Clark-Babbitt Industries, Inc., and executive vice-president, National Fireworks, Inc., West Hanover, Mass.

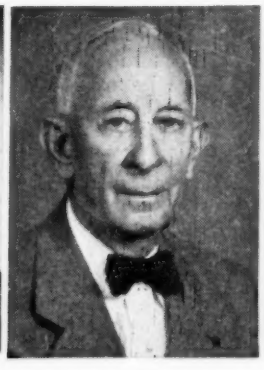
Abner Y. Leech, Jr., Washington, D. C., charter member of the Army Ordnance Association, has spent over fifty years in active Ordnance work. As treasurer of the United States Ordnance Company he has taken a preëminent part in the development of many important weapons for the U. S. services.

Capt. Robert D. Conrad, U.S.N., Retired, is assistant director of the Brookhaven National Laboratory, Upton, L. I., N. Y. Captain Conrad, an Annapolis graduate in 1927, has had a long and notable career in naval development and construction including ordnance.

Roy F. Williams, Boston, Mass., is the well-known and highly regarded executive vice-president of Associated Industries of Massachusetts—the official spokesman for Massachusetts industry. He is also editor in chief of the nationally known publication, *Industry,* and has performed yeoman service to the Ordnance cause.

Maj. Winston A. Jones is professor of military science and tactics of the Atlanta Public High Schools. He was captured in Bataan and escaped from the "death march" to organize guerrilla warfare against the Japs.

Col. James S. Crawford



A. Y. Leech, Jr.

Capt. Robert D. Conrad

Roy F. Williams

Winston A. Jones

Month by Month: A Review of the National Defense Situation

Annual Meeting.—The Twenty-ninth Annual Meeting of the Association was held at the Waldorf-Astoria Hotel, New York City, on October 1st, and at Aberdeen Proving Ground, Md., on the following day. The general theme of the meeting was National Security Now.

At the first session in New York an ordnance clinic was held for the consideration of technical and scientific phases of ordnance progress. An industrial preparedness luncheon was followed by a general meeting of the presidents and officers of all Posts and chapters of the Association. Later in the day there was a meeting of Council of the Association which was attended by the national officers and directors.

The annual dinner meeting at the Waldorf was attended by more than one thousand members and guests. Secretary of Defense James Forrestal was the principal speaker. The program concluded with the following awards for distinguished Ordnance service: The Williams Gold Medal, to Mr. Forrestal; the Crozier Gold Medal, to Henry L. Stimson, Secretary of War during World War II; the Crowell Gold Medal, to Edward B. Gallaher, Clover Manufacturing Company, Norwalk, Conn.; the Scott Gold Medal, to R. E. Gillmor, Sperry Corporation, New York, N. Y.; and the Rice Gold Medal, to C. K. Davis, Remington Arms Company, Bridgeport, Conn.

The second session of the annual meeting was held on October 2nd at Aberdeen where a program of current tests and demonstrations was presented.

The next issue of ORDNANCE will be devoted to a complete report of all the speeches and activities of the Annual Meeting.

The Fate of the World.—In a speech bristling with censure of Russia, Secretary of State Marshall challenged the United Nations to make a supreme effort to break the world's deepening political and economic crisis. Here is General Marshall's 7-point program:

1. Greece: The United States will submit to the Assembly a resolution squarely blaming Yugoslavia, Albania, and Bulgaria for Greece's border troubles, calling on them to stop supporting Greek Communist guerrillas and creating a special commission to watch over the explosive Balkan situation.

2. Palestine: The United States gives serious weight to the proposals of a United Nations commission for partitioning the Holy Land between the Jews and Arabs.

3. Korea: After two years of futile negotiations with Russia on Korean independence, the United States will submit suggestions for restoring Korean independence but looks to the impartial judgment of the Assembly for a solution.

4. Atomic energy: Two members of the Atomic Energy Commission (Russia and Poland) have blocked agreement in the commission on control machinery. Unless the minority agrees soon, the commission may be confronted with complete failure.

5. Arms regulation: A workable system of arms control is impossible until conditions of international confidence prevail in the world, but America wants the U.N. arms commission to proceed vigorously with its task of planning armament regulations under the Security Council.

6. Veto: The abuse of the veto right has prevented the Security Council from fulfilling its true function. The United States intends to propose that the Assembly create a special committee to study ways and means of liberalizing the veto and report next year.

7. Security Committee: The Assembly now has so much work to do that it needs an agency to remain in session all the time, keep an eye on the world's troubles, clear up routine matters as they arise, and recommend a special session of the full Assembly when necessary.

District Chiefs.—The recent appointment of William H. Mitchell as chief of the Cincinnati Ordnance District, and of John S. Pfeil as chief of the Boston Ordnance District, brings to seven the number of Ordnance districts now under civilian leaders.

Mr. Mitchell, president of the Mitchell Steel Company of Cincinnati, organized the Ridgewood Steel Company in 1941 to manufacture gun tubes and shells. He is a member of A.O.A.'s Artillery Committee.

Mr. Pfeil, a vice-president of Stone and Webster, Inc., was formerly deputy district chief of the Boston Ordnance District. For seventeen years he was associated with General Motors as public relations representative for the New England area.

Four appointments previously made are: Detroit, Edward T. Gusheé; Rochester, Lyman K. Stuart; Springfield, John S. Begley; and St. Louis, Adrian W. Frazier. Don M. Compton has headed the Chicago District for some years.

Atomic Medicine.—The Navy's Bureau of Medicine and Surgery recently announced that it has ordered the commanding officers of naval hospitals to form a local board for the control of radioisotopes which will be used clinically in all their institutions. The order follows a ruling by the Atomic Energy Commission that the human application of the radioisotopes must be controlled by a local board in each hospital.

Each board will be composed of three specialists: (1) a medical officer who is well versed in the physiology and pathology of blood-forming organs; (2) one whose specialty is metabolism and metabolic disorders; and (3) a biophysicist, radiologist, or radiation physiologist qualified in the technic of radioisotopes.

This new field of radioisotopes and the future that it may offer for healing the sick has stimulated much research.

Canadian Peacetime Arsenals.—The extension of the peacetime uses of government-owned arsenals is being considered in Canada.

Before World War II, only one government arsenal was active, and Canadian industry found itself without the background and knowledge of special manufacturing processes involved in war production. As a result, according to Maj. Gen. J. H. MacQueen, president of Canadian Arsenals,

Limited, it took three years after the outbreak of war before the effect of Canadian production was felt on the battle front.

With this experience in mind, the government has retained in operation seven arsenals to meet the peacetime requirements of the armed forces and to maintain some measure of industrial preparedness for an emergency.

Fuel Crisis.—Representatives of the American oil industry have promised to provide the armed forces with sufficient petroleum to meet their needs. The oil men agreed that "the military demand must and will be met." It is expected that the petroleum industry will meet the military requirements and then apportion its remaining products among commercial consumers.

The National Petroleum Council's Committee on Military and Government Requirements stressed the need of a central procurement agency which would forecast petroleum needs in advance and permit the industry to anticipate demands and prepare to meet them.

Secretary of the Army Kenneth C. Royall stated that centralized procurement had long been his aim, and he is hopeful that such a program will be developed under unification. He expressed doubt, however, that such a plan could be effected immediately.

Air Power.—The President's Air Policy Commission, composed of five distinguished civilians from widely separated fields, began an inquiry designed to find the answer of security for the United States in an age of warfare based on atomic power and guided missiles carrying destruction almost beyond the imagination of the present day.

The commission will study all problems of civil as well as military air transport and manufacturing, but even its routine studies will be directed always toward the question of how much or how little time the United States has to perfect its defenses against any overwhelming attack by potential future enemies.

In addressing the first convention of the Air Force Association in Chicago, Gen. Dwight D. Eisenhower called for an air force to compel peace in the world.

"In all the free world," he said, "men would breathe more easily, work more earnestly in the present, plan more confidently for the future, if they were assured that the United States would continue first in the air, as strong and as stanch in the maintenance of a just peace as it was mighty and forceful in the pursuit of unconditional surrender."

Rio Conference.—In addressing the closing session of the Inter-American Defense Conference at Petropolis, Brazil, President Truman had this to say:

"The fundamental basis of the policy of the United States is for permanent world peace. We are determined that, in the company of our friends, we shall achieve that peace.

"We are determined because of the belief of our people in the principle that there are basic human rights which all men everywhere should enjoy. Men can enjoy these rights—the right to life itself and the right to share fully in the bounties of modern civilization—only when the threat of war has been ended forever.

"The attainment of world-wide respect for essential human rights is synonymous with the attainment of world peace. The people of the earth want a peaceful world, a prosperous world, and a free world, and when the basic rights of men everywhere are observed and respected there will be such a world."

Recruitment.—The Army's strength has fallen to approximately 965,000 men, or about 105,000 fewer than the needed strength of 1,070,000, and the recruiting trend is downward. Army officials are worried lest a long continuance of the trend might cause a curtailment of occupation and other tasks.

Air Force recruitment was sharply better. In June the Air Force obtained 10,350 volunteers, in July 12,640, and in August 11,240. An average of only 9,000 men a month will be needed to attain the December 31st goal of fifty-five fully manned groups and an additional twelve in at least skeletonized or "shadow" form by June 30, 1948.

Navy personnel officers raised the possibility of reducing ships' complements or even of laying up ships if recruiting fails to meet the monthly goal of 15,000 men. Only 11,746 were recruited in August.

Meanwhile the National Guard carried on an intensive recruiting campaign, with a minimum goal of 88,888 new men. The National Guard, with a target strength of 682,000, has been allotted a total of 6,382 units, of which 3,017 have thus far been given Federal recognition.

Contemporary Germany.—Two distinguished A.O.A. members have recorded their firsthand observations on conditions in Germany and have made positive recommendations.

M. H. Eisenhart, president of Bausch & Lomb Optical Company, Rochester, N. Y., outlines the basic problem as follows: Sixty-eight million people in the "new Germany" must eat and live like civilized human beings. They cannot produce nearly enough food to satisfy themselves. Therefore a substantial number must either leave the country or must produce for export enough manufactured products, over and above their own needs, to satisfy the bill for the food and raw materials which they must import. If this is not done, Communism will sooner or later establish itself in Germany and the rest of Europe as well.

Mr. Eisenhart advises concentration on the food, coal, and transportation shortages; the postponement of decartelization regulations; the adoption of incentives for industry, agriculture, and labor; a supply of consumer and capital goods to accompany the drive for exports; prompt agreement on a reparations program; speedy completion of the denazification program; and the adoption of all measures recommended by Herbert Hoover.

A second report on Germany, prepared by Walter Harnischfeger, president of the Harnischfeger Corporation, Milwaukee, Wis., is more critical of American military occupation policy. He believes that special attention should be given to the housing shortage, to the emigration of surplus population, to the reduction of our occupation troops to an efficient police force, and to currency stabilization.

Sunlight in a Dark World

The Inter-American Treaty against War

¶ The Army Ordnance Association has adopted as its primary long-range aim—"adequate national security." This is the great goal—*peace*. It is best obtained through a nonpartisan and persistent national policy which will ensure that the amount of military power—ground, sea, and air—available to this country *and its probable friends* will never be less than that available to its probable enemies.

¶ A corollary aim, and one to the attainment of which the Association has in the past made substantial contribution, is adequate munitions power. This is one of the two basic foundations of military power. The amount of it in quality and quantity available to the United States *and its probable friends* should never be less than that available to its probable enemies.

¶ At the recent Inter-American Conference at Rio de Janeiro, nineteen sovereign American states, speaking four different languages, reached formal agreement on the precise terms of the treaty for complete coöperation in the mutual defense of each other and of the Western Hemisphere. The treaty is not against any nation or group of nations. It is not against any race or religion. It is not against any system of economics or ideological belief. The Inter-American Treaty of Reciprocal Assistance is *against war*—ruthless, aggressive war.

¶ Hon. George C. Marshall, Secretary of State, reports to the people of the United States: "The purpose of the treaty is to provide for the peace and security of the Western Hemisphere. It lays down in precise terms the agreed action to be taken in case of aggression from without or of aggression within the hemisphere."

¶ The stipulated course of action in the event of aggression from within or without is set forth explicitly in Article 8 of the treaty and comprises one or more of the following: "Recall of chiefs of diplomatic missions, breaking of diplomatic relations, breaking of consular relations, complete or partial interruption of economic relations or of rail, sea, air, postal, telegraphic, telephonic, and radio telephonic or radiotelegraphic communications and the use of armed force."

¶ So the treaty realistically recognizes the possibility of aggressive action and the consequent necessity for "the use of armed force" to repel aggression and restore peace within the Western Hemisphere. Armed forces require arms—in brief, ordnance. To be most effective, ordnance should be standardized throughout the hemisphere; and this will place increased responsibilities upon all those who during World War II designed and produced the tools of Victory—and Peace.

¶ It is worthy of note that the treaty uses the expression "American states" in the broadest possible, and really correct, sense. It refers constantly to "the American republics," "the American regional community," "the inter-American system," "inter-American peace and security," in a way to indicate that hereafter "America" consists of North America, South America, and Central America. The nineteen American republics are truly, and of right ought to be, referred to as American states.

¶ The obvious desirability of standardizing ordnance throughout the Western Hemisphere, considered with the broadened meaning of "American," lends considerable force to the proposal advanced by the Washington Post, A.O.A., to change the name "Army Ordnance Association" to "American Ordnance Association."

¶ The Association is a democratic organization and the proposal is following the course prescribed in the constitution. If approved by a majority of the membership, the change in name may well foreshadow expanded areas of influence for the Association and its publications.

¶ In the meantime, we gladly join with Secretary Marshall in hailing the Treaty as "the most encouraging, most stimulating international action since the close of hostilities."

¶ We also believe, with our wise and gifted Secretary of State, that "the successful formation of this regional treaty affords the United Nations a significant example, an example . . . of which it is in great need at the present time."

¶ The Treaty is indeed a gleam of sunlight in a dark world.

James L Walsh

President, Army Ordnance Association.

Association Affairs

R.O.T.C. ORDNANCE: Many Units Now in Operation

Announcement has been made of the establishment of a number of new Army Ordnance R.O.T.C. Units at educational institutions throughout the country. The Ordnance officers who will be in charge as assistant professors of military science and tactics have also been named. The complete roster of Ordnance R.O.T.C. Units now actively in operation and the officers in charge are:

Cornell University, Ithaca, N. Y., *Capt. M. C. Louden;* Massachusetts Institute of Technology, Cambridge, Mass., *Lieut. Col. R. S. Crossman;* University of Cincinnati, Cincinnati, Ohio, *Lieut. Col. J. E. Foxx* and *Capt. C. W. Holmes;* Lehigh University, Bethlehem, Pa., *Lieut. Col. B. D. Beach;* Ohio State University, Columbus, Ohio, *Maj. F. F. Poppenburg;* Pennsylvania State College, State College, Pa., *Capt. E. F. Kensok;* Virginia Polytechnic Institute, Blacksburg, Va., *Capt. W. L. Lockett;* Purdue University, Lafayette, Ind., *Capt. H. E. Attaya, Jr.;* Clemson Agricultural College, Clemson, S. C.; *Capt. W. L. Bynum;* Georgia School of Technology, Atlanta, Ga., *Maj. W. H. Waikart;* North Carolina State College, Raleigh, N. C., *Capt. J. R. F. Bond;* The Citadel, Charleston, S. C., *Lieut. Col. G. D. Stephens;* University of Tennessee, Knoxville, Tenn., *Maj. H. R. Suess;* Louisiana State University, Baton Rouge, La., *Lieut. Col. R. E. Phillips* and *Capt. J. H. Walbridge;* Oklahoma A. & M. College, Stillwater, Okla., *Capt. J. M. Whisenhunt;* A. & M. College of Texas, College Station, Tex., *Lieut. Col. F. R. Swoger;* University of Oklahoma, Norman, Okla., *Capt. M. C. Foster.*

This is a splendid beginning toward the establishment of Ordnance units in our leading colleges and technical institutions. It is to be hoped that ten times as many as those already announced will be in operation ultimately.

Already steps have been taken for the inauguration of student chapters of the A.O.A. at every institution where an Ordnance R.O.T.C. Unit is located. Through the medium of such local units, the students are brought into closer contact with the problems of ordnance preparedness and, through seminars conducted by the local chapters, are enabled to obtain a broad perspective of the obligations of industrial readiness.

YANKEE POST: Holds Annual Election of Officers

The Yankee Post held its annual meeting for the election of officers on September 18th. Col. James S. Crawford, one of the best known and admired officers of the Ordnance Department, now actively engaged in industry in Massachusetts, was elected president of the Post. Jim served as executive officer of the Boston Ordnance District and in early days of World War II as chief of that district. He has many friends throughout the area who actively assisted him in the mobilization of Massachusetts industry for victory in World War II.

Other officers elected were: 1st vice-president, Frederick L. Felton; 2nd vice-president, H. W. Bagnall; 3rd vice-president, F. W. Knauth; secretary-treasurer, G. P. Slade.

Directors elected to serve three years were Henry S. Chafee, Ralph Gow, Richard S. Morse. Roy F. Williams was elected a director to complete the term of C. S. Robinson, deceased.

Ralph Gow was chosen to represent the Yankee Post in Council of the national Association.

The Yankee Post took a leading part in mobilizing attendance at the Twenty-ninth Annual Meeting of the Association at Aberdeen on October 2, 1947. Special railroad cars were operated from Boston and Worcester. These were attached to the Ordnance Special which left Pennsylvania Station at 6:25 A.M. and carried the delegation directly to the Aberdeen Proving Ground. Arrangements were in the capable hands of George Paul Slade, secretary of the Post.

ORDNANCE RESERVE OFFICERS: 600 Attend Spirited Session in New York

An unusually fine meeting of Ordnance Reserve officers took place on Wednesday, September 10th, in New York City at the Western Union Auditorium.

The 4 Ground Force Ordnance Reserve units which comprise some 1,200 officers and 1,300 enlisted men residing in the southern section of New York State sponsored the program to which the Ordnance officers of New Jersey were also invited. The meeting was presided over by Col. Henry N. Sachs, commanding officer, 179th Organized Reserve Ordnance Group.

After an invocation by Maj. (Chaplain) Charles W. Newman, Col. J. M. Thompson, Assistant Chief of Staff, G-4, First Army, presented flags to Col. R. O. Ford, commanding officer of the 307th Ordnance Group; to Col. Myron C. Doucette, commanding officer, 132nd Organized Reserve Ordnance Group; to the 803rd Ordnance Depot; and to Colonel Sachs for the 179th. Colonel Thompson, who was wartime Assistant Chief of Staff, G-4, of the India-Burma Theater, lauded the work of the Ordnance maintenance units in that theater, and explained the vital rôle they played in the construction and use of the Stilwell Road.

Following this, the commanding officers of the various units briefly outlined the training programs for the coming season.

The high light of the evening was an address, "Modernized Ordnance Service for the Ground Forces," by Col. J. B. Medaris, presently executive officer to the Chief Ordnance Officer, Army Ground Forces. As Ordnance Officer, II Corps, in Tunisia and Sicily and later with the First Army in the European Theater, Colonel Medaris has had outstanding experiences.

The Ordnance service in the modernized (or interim) Army will stress mobility, he said, with an emphasis on tactics equal to or exceeding that of logistics. Out of the welter of World War II experience we have learned the need for the close interconnection of supply and maintenance and for the recovery, classification, and rehabilitation of equipment as far forward as possible.

Over 600 Ordnance enthusiasts attended, among them such honored guests as Maj. Gen. R. L. Maxwell (Ret.); Col. J. W. Coffey, professor of ordnance and gunnery, U. S. Military Academy; Col. Arthur Ford, commanding officer, Raritan Arsenal; James L. Walsh, president, Army Ordnance Association; Col. D. L. Van Sickle, Ordnance Officer, First Army, as well as a large part of the staff of the First Army.

NECROLOGY

Brig. Gen. Samuel McRoberts, a member of the Committee on Organization of the Army Ordnance Association in 1919 and a director of the Association continuously during the past twenty-nine years, died in New York City on September 8, 1947. He was chairman of the board of McRoberts & Tegtmeyer, Inc., exporters, and lived in Chestnut Ridge Road, Mount Kisco, N. Y.

Few men have had greater influence on ordnance affairs of the past three decades than had General McRoberts. In World War I he was called from his post as vice-president of the National City Bank of New York to direct the vast procurement organization of the Ordnance Department of the Army. He was the first chief of the Ordnance Procurement Division in World War I and subsequently served overseas in connection with procurement activities. For his achievements in that war, he was awarded the Distinguished Service Medal.

When the first steps were taken for the organization of the Army Ordnance Association in 1919, General McRoberts, who had returned to the banking industry and was then president of the Chatham Phoenix National Bank & Trust Company, took an active part as a member of the original Committee on Organization. He was chosen a director of the Association at the first election in 1919 and continued to serve without interruption through all the remaining years.

General McRoberts was born in Malta Bend, Mo., and was graduated from Baker University at Baldwin, Kans., in 1891. Two years later he received a law degree from the University of Michigan. He was appointed an attorney for Armour & Company in 1895 after practicing law in Chicago, and in 1904 he became treasurer of the company.

In 1909 he came to New York, where he was associated with the National City Bank. He handled a great deal of work in the foreign investment field before he left the position in 1918.

Returning from overseas duty in 1921, he was named president of the Metropolitan Trust Company, remaining until 1925. At that time he became chairman of the board of the Chatham Phoenix National Bank & Trust Company, a position he held until 1932.

All friends and supporters of the Ordnance cause through the years will join in tribute to this citizen-soldier who gave of his best talents in war and in peace.

Lieut. Gen. James G. Harbord, U. S. Army (Retired), charter member of the Army Ordnance Association and an active participant in many of its activities through the years, died at his home in Rye, N. Y., August 20, 1947.

As Chief of Staff of the American Expeditionary Forces in World War I, and notably as director of Services of Supply, General Harbord won a name as tactician and administrator which will stand high in the annals of American military success.

General Harbord, then Major, was chosen by Gen. John J. Pershing to be among that small band who sailed with him to France in 1917. He was given the task of organizing and training the great numbers of soldiers who were to comprise the A.E.F. His first battle assignment was to command the 4th Marine Brigade which stopped the Germans at Belleau Wood. Later General Harbord was made commander of the 2nd Division in the Soissons offensive.

To increase the efficiency of the Services of Supply system of the A.E.F., General Harbord was withdrawn from the front and placed in charge of S.O.S. where his great energy, resourcefulness, and tact were instrumental in keeping up the continuous flow of the mammoth quantities of munitions needed at the battle fronts.

Following the war, when General Pershing became Chief of Staff General Harbord was appointed his deputy. After a tour as Chief of Staff, he retired from the Army to devote his energies to the advancement of radio communication in which field, as chairman of the board of the Radio Corporation of America, he rendered distinguished service.

General Harbord was particularly close to the Army Ordnance Association and to the men who founded it. All his confreres of the Ordnance fraternity will join in according him the highest acclaim as soldier, battle commander, able executive, and expert in leading the men who fired the guns and in exhorting the men who serviced them.

Dr. Christian George Storm, a charter member of the Army Ordnance Association and one of the founders of the Washington Post, A.O.A., died suddenly at his home near Great Falls, Va., on August 24, 1947. He was a noted authority in the field of explosives and studied at Columbian College under the late Dr. Charles E. Munroe, discoverer of the famous "Munroe effect" of explosives. Dr. Storm had an unusually wide circle of friends in the Army Ordnance Association, the Ordnance Department, and among other workers in the field of military explosives.

Dr. Storm was born on November 20, 1877, at Boscobel, Wis.; received degrees of B.S. (1898), M.S. (1899), Ph.D. (1916), all from Columbian College—now George Washington University; served as assistant and instructor in chemistry at Columbian College, 1899-1901; as explosives chemist, Naval Powder Works, 1901-1909; and at the Bureau of Mines, 1909-1915; was directing chemist for Aetna Explosives Company, 1915-1917; consulting explosives chemist and lieutenant colonel, Ordnance Department, 1917-1919; research chemist, Trojan Power Company, 1919; professor of chemical engineering, Ordnance School of Application, Aberdeen Proving Ground, 1920-1921; chief of explosives section, Office of the Chief of Ordnance, 1921-1942; technical director, National Fireworks Company, 1942-1945. He retired in 1945.

Holder of a commission as colonel in the Ordnance Reserve Corps from 1923, Dr. Storm was an active member of the Army Ordnance Association and of the American Chemical Society, serving as secretary of the Pittsburgh section of that society from 1914 to 1916. He served also a coeditor (with Dr. Munroe) of Section 24 (Explosives) on *Chemical Abstracts* from 1931 to 1938, and as editor after Dr. Munroe's death in 1939. A quiet, unassuming man, he was a strong and constant advocate of chemical research and development for the improvement of American ordnance. He will be missed greatly by his many associates of the Ordnance fraternity in which he held high place.

John A. Taylor, assistant general manager of the Bethlehem (Pa.) plant of Bethlehem Steel Company, died August 12th at the age of 44. He had been ill since April.

A native of England and a graduate of McGill University, Montreal, Mr. Taylor entered the employ of Bethlehem Steel in 1924 as a trainee in the "Loop" course, advancing thereafter in positions of responsibility. During World War II, as superintendent of the lower manufacturing division of the Bethlehem plant, comprising the forge specialty department and Nos. 4 and 5 forges, he was in direct charge of the company's principal ordnance divisions, then producing guns and shells for the U. S. Army.

In 1945, Mr. Taylor was made chief engineer of the plant, in which capacity he served until his appointment as assistant general manager in September 1946. He was a member of the Army Ordnance Association, Lehigh-Bethlehem Post.

NOTICE also has been received of the deaths of the following members of the Association: C. H. M. Atkins, Cincinnati, Ohio; W. J. Cleary, Detroit, Mich.; L. P. Dendel, Lansing, Mich.; E. H. Devor, Detroit, Mich.; H. F. Eikost, Toledo, Ohio; S. M. Elliott, Akron, Ohio; L. P. Finley, Columbus, Ohio; W. C. Gaddis, Anderson, Ind.; E. J. Guilbeau, Tullas, La.; C. M. Johnson, Highland Park, Mich.; W. W. Kagi, Western Springs, Ill.; L. L. Kahn, San Francisco, Calif.; S. E. Lenox, Endicott, N. Y.; L. H. Moehring, Detroit, Mich.; F. A. Pixley, Columbus, Ohio; E. R. Rattray, Cleveland, Ohio; George Rychner, Toledo, Ohio; E. K. Schadt, Birmingham, Mich.; A. K. Stewart, Springfield, Ohio; J. A. Taylor, Bethlehem, Pa.; Lawrence Terbrueggen, Grosse Pointe Farms, Mich.; and F. C. Whitmore, State College, Pa. To their relatives and friends, ORDNANCE, on behalf of the Association membership, extends condolences.

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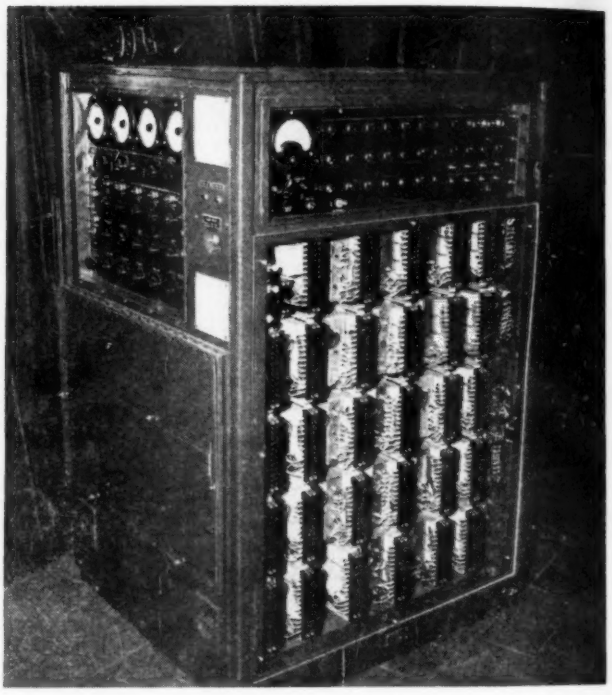
Professional Digest

ORDNANCE INSTRUMENT EXHIBIT

The Ordnance Department took part in the "Instrumentation for Tomorrow" exhibition of the Instrument Society of America held in Chicago at the Stevens Hotel last September. An exhibition booth was made available to the Ordnance Department through the kindness of Ralph Goetzenberger, an official of the Instrument Society and a well-known member of the Army Ordnance Association.

Under the direction of Col. G. M. Taylor, Office of the Chief of Ordnance, and Don M. Compton, chief of the Chicago Ordnance District, an educational display was set up that clearly demonstrated to the large crowds of instrument manufacturers and their friends the strides the Ordnance Department has made in the design, procurement, and use of instruments using the most modern scientific techniques.



Computer for the M9A2 director.

The Western Electric Company assisted in the preparation of the exhibit by contributing the featured item, a large hand-painted mural attractively depicting the use of the antiaircraft gun director M9A2 in combat. This is an electromechanical device designed by the Bell Telephone Laboratories and manufactured for the Ordnance Department by Western Electric for controlling the fire of 90-mm. antiaircraft gun batteries.

Other exhibit pieces were plaques of proximity fuzes and subminiature tubes prepared by the Ordnance Development Division at the National Bureau of Standards. There was a pressure gage plaque and demonstration unit prepared jointly by Aberdeen Proving Ground and Frankford Arsenal.

The scope of this exhibit clearly demonstrated the progressive manner in which the Ordnance Department is maintaining a high standard of instrumentation.

YOUR TELEPHONE TRANSMITTER AND RECEIVER, *voice gateways to the telephone plant, are so essential to satisfactory service that they have been under study in Bell laboratories for seven decades.*

A TELEPHONE RECEIVER is a complex system of electrical and mechanical elements. Its coils, magnets, diaphragm and cap react on each other as they convert the electrical waves of your voice to sound waves. What is the best size for the holes in the ear cap? Will 1/1000th inch greater thickness help a receiver diaphragm to carry your telephone voice more clearly? One way to find out is to build numerous experimental receivers and test them.

But Bell Laboratories have found a shorter way. They built an all-electrical replica, an "equivalent circuit" in which electrical resistance stands for air friction in the cap holes; capacitance corresponds inversely to the stiffness of the diaphragm. Performance of this circuit can be quickly measured and design changes economically explored. Later, a model can be built and checked.

The "equivalent circuit" was pioneered by Bell Telephone Laboratories 25 years ago. It is a useful tool in many Laboratories developments—saving time, saving the cost of machine-tooled models, encouraging experimentation. It is one more example of the way Bell scientists get down to fundamentals as telephone progress continues —and service keeps on improving for all subscribers.

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General maintenance	26%
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Communications

STORAGE OF MACHINE TOOLS

THE EDITOR.—I noticed in a recent issue of ORDNANCE the article, "A Machine Tool Reserve." This subject has not received sufficient attention by any of our governmental agencies. As it is quite evident to the writer, who has purchased for both his company and his individual investment some first-class machine tools at very low prices, these machines, as well as others which were used in the manufacture of war matériel with which the writer is familiar, are being disposed of at extremely low prices.

Some of the tools which are sold for scrap or salvage, while they are not standard equipment desired by the usual shop, are machines which were in very short supply during the war and which would be usable in our next war emergency.

It is really heartbreaking to one who knows machine tools to see these machines disposed of, for, as this article pointed out, any old machine that could be used was of necessity put into the manufacture of war matériel for our allies and ourselves in World War II.

It is to be hoped that all usable surplus manufacturing equipment will be stored in some of the many war plants owned by the Government.

R. A. COLGIN

Tulsa, Okla.

■ **The article "A Machine Tool Reserve," referred to above, appeared on page 21 of the July-August 1947 issue of ORDNANCE. It recommended that surplus Government machine tools should be placed in a war reserve and not sold or leased to industry except under certain specified conditions.—THE EDITORS.**

RUSSIAN A-BOMB PLANT

THE EDITOR.—Several months ago Father Hubbard, the Glacier Priest, was quoted as saying that the Russians had an atomic bomb plant last year, but that it blew up. He thought the reason might have been that "one of the professors forgot a decimal point." It may also have been that some of the atom secrets stolen by Russian spies were booby trapped.

I have not heard about this Russian atomic bomb plant from any other source and am interested in knowing if any one else has.

Father Hubbard said this plant was forty-five miles northeast of Moscow. This looks as if the Soviet Government was afraid to let such power get very far from their apron strings, for they have in Siberia a wilderness in which a fallen comet remained undiscovered for twenty years, although nobody had any reason for hiding it. That wilderness is the sort of location a free country would choose for a secret plant, and if the Soviet Government is afraid to use it that may be greatly to our advantage.

Kravchenko could destroy the Kremlin with a single atom bomb, and if the Kremlin had known he would choose freedom they wouldn't have sent him here as a spy. Henry (*Oh Gawd!*) Wallace would need at least a thousand atom bombs to make an equally radical change in the United States will to fight. That is a fundamental difference, inherent in the two forms of government, and it gives us a big advantage in modern forms of war. Also, I think a motorized civilization is less vulnerable than a horse-and-droshky one.

MAJ. JAMES R. RANDOLPH

Orange, N. J.

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Peace insurance begins on jobs like this!

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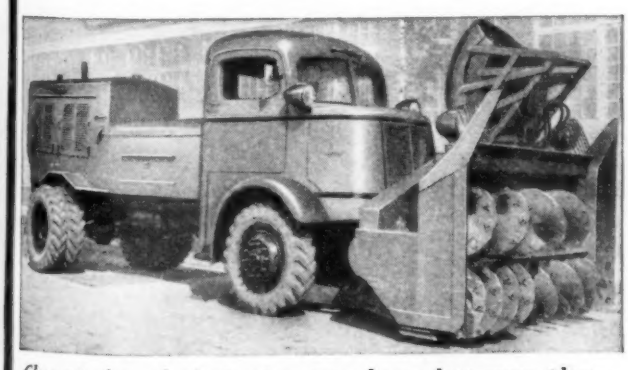

Close-up view of giant rotary-type, heavy-duty snow plow.

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Atomic Energy

NEW URANIUM

Discovery of new uranium deposits in Canada's northlands was disclosed recently by C. D. Howe, Canadian Reconstruction Minister, at a news conference dealing with atomic-energy developments.

SPECIAL WEAPONS PROJECT

The Armed Forces Special Weapons Project has been established as a joint Army-Navy organization which will discharge all military service functions relating to atomic energy. The project has assumed the responsibility of carrying on those military service functions of the Manhattan Project which were retained under control of the armed forces at the time the Manhattan Project was turned over to the Atomic Energy Commission. The program of the AFSWP includes training of special personnel, military participation in the development of atomic weapons of all types, and developing and effecting joint radiological safety measures in coördination with established agencies.

NUCLEAR PHOTOGRAPHY

Special photographic plates made in the laboratories of Eastman Kodak Company, Rochester, N. Y., are being used by scientists to picture actual atomic fission and to study action of highly charged nuclear particles. The plates are known as "nuclear track" plates from their special use in recording the paths of the particles.

Characteristics of the new plates are markedly different from those of ordinary photographic materials. The plates are supersensitive to the electric charges carried by atomic particles but are relatively insensitive to light—which affects ordinary film—and to X-rays. The silver grains in the emulsions of the nuclear-track plates are unusually close-packed. It is these silver grains, suspended in the gelatin emulsion, that are particularly sensitive to the charged nuclear particles.

When a highly charged particle speeds into the emulsion, a dotted line of affected silver grains is produced. These silver grains, when the plate is developed, make an identifiable track showing the path of the nuclear particle through the emulsion.

LOS ALAMOS MADE PERMANENT

The Atomic Energy Commission has announced that the atomic bomb factory at Los Alamos is being put on a permanent basis. Carroll L. Tyler, retired Navy captain and ordnance expert, will be in charge of the Los Alamos laboratory succeeding Col. Herbert C. Gee, Army Engineer who had been on loan to the Commission since it took over the Manhattan Project at the start of this year.

NUCLEAR ENERGY SCHOOL

A new school at Oak Ridge, Tenn., for scientists and engineers conducting research on the use of nuclear energy for the propulsion of aircraft was begun during the past summer.

The program for the study of nuclear energy for the propulsion of aircraft, known as the Fairchild-N.E.P.A. project, is a combined operation of ten aircraft-engine companies and the National Advisory Committee for Aëronautics, working with the Fairchild Engine and Airplane Corporation as prime contractor under the Air Force.

The Backbone of Cost Saving Dimensional Control

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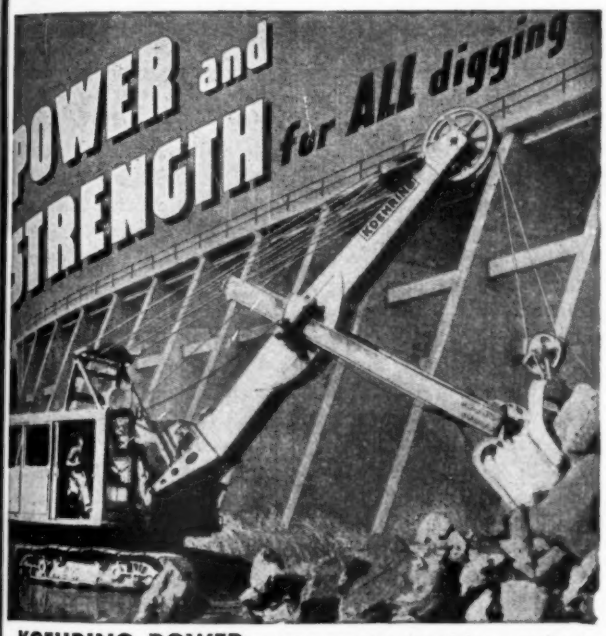

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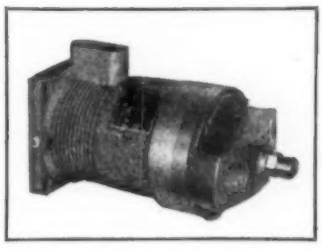

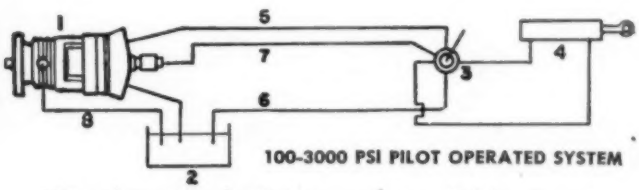

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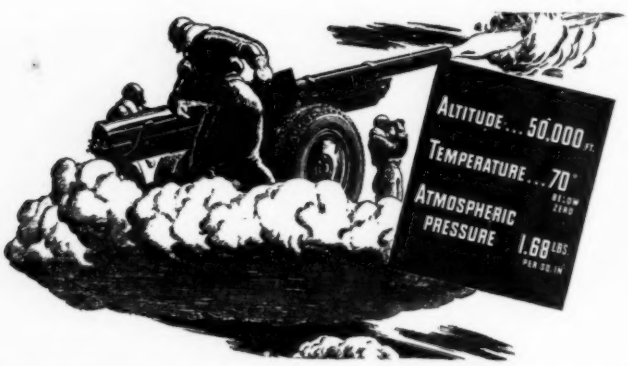

WHAT HAPPENS WHEN YOU FIRE A 75 IN THE STRATOSPHERE

That's the sixty-four dollar question in the Air Corps today. And to get the answer, York built a twin-cell strato-chamber which simulates the flight of a giant bomber, soaring from sea level to more than 50,000 feet in twelve minutes. In that time, temperature is reduced from +70°F. to −70°F. and air pressure from 14.7 pounds to 1.68 pounds per square inch. Thus U.S. airmen know what happens to firing mechanisms, gun barrels and ammunition subjected to this sudden drop of 140° in temperature. And, as always, what they learn will one day find unsuspected corollaries in the arts of peace. York Corporation, York, Pennsylvania.

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YORK REFRIGERATION AND AIR CONDITIONING
HEADQUARTERS FOR MECHANICAL COOLING SINCE 1885

Guided Missiles

CORPORAL E ROCKET

Firing tests have begun on Corporal E, a new high-altitude rocket developed by the Army Ordnance Department. The first of the type has been fired successfully at the proving grounds at White Sands, N. Mex., and the results are now being studied.

The rocket has no mechanism for guidance and is described as "not very flexible." It has been under development for more than two years by the Douglas Aircraft Company. It is reported that the Corporal E can carry a pay load of 500 pounds to a maximum altitude of 78 miles or 100 pounds to 93 miles.

Ten of the new missiles have been ordered and will be fired on a regular program of high-altitude investigation.

"SUPER METALS" FOR ROCKETS

A new group of "super metals" and ceramics soon will be available for man's new high-powered machines, the turbo-jet, rocket motors, and atomic-energy power plants, Clyde E. Williams, director of Battelle Memorial Institute, Columbus, Ohio, stated recently. They will withstand higher temperatures and pressures than materials now available, he said, and will offer potentialities for power generation that are "simply staggering."

THE NEPTUNE NAVY ROCKET

A number of rockets for test purposes which, it is reported, will reach a speed of 8,500 feet a second are being built by the Glenn L. Martin Company, Baltimore, Md., for the U. S. Navy. Named Neptune, the new rockets will replace the fast-disappearing supply of German V-2 rockets and will offer many advantages not possessed by the V-2's.

It is said that the top speed of the Neptune will be reached when the rocket is carrying a pay load of one hundred pounds and will occur at a height of thirty-eight miles above the earth's surface seventy-five seconds after launching. At that height and time the fuel supply of liquid oxygen and alcohol will be exhausted, but the Neptune will "coast" to a height of 235 miles.

In addition to the extreme height which will be reached, the Neptune is said to offer several advantages over the V-2. Although weighing but 10,000 pounds empty, the Neptune can carry a pay load of from 100 to 1,400 pounds. The V-2 had a minimum pay-load factor of 1,700 pounds, which limited its range.

The V-2 also was difficult to control in flight because it used carbon vanes in the exhaust stream to control the direction of thrust. In the Neptune, the rocket engine is mounted in gimbals with a control gyro dictating the reorientation of the line of thrust.

Maximum height and speed in the Neptune will be reached when the rocket is carrying the minimum pay load. Should this pay load be of 500 pounds, for example, the maximum height to be reached will be 200 miles, and maximum speed at exhaustion of fuel, 7,000 feet per second. Greater pay loads mean further reductions in speed and height.

The Neptune will be forty-five feet long, about the same length as the V-2, but will be much slimmer, being only thirty-two inches in diameter. The contract calls for the building of 10 full-sized rockets at a cost of $1,850,000, with delivery scheduled over a 3-year period.

The Navy hopes to be able to fire the Neptune from shipboard, though no figures have been released to show its possible range when fired horizontally as a rocket weapon.

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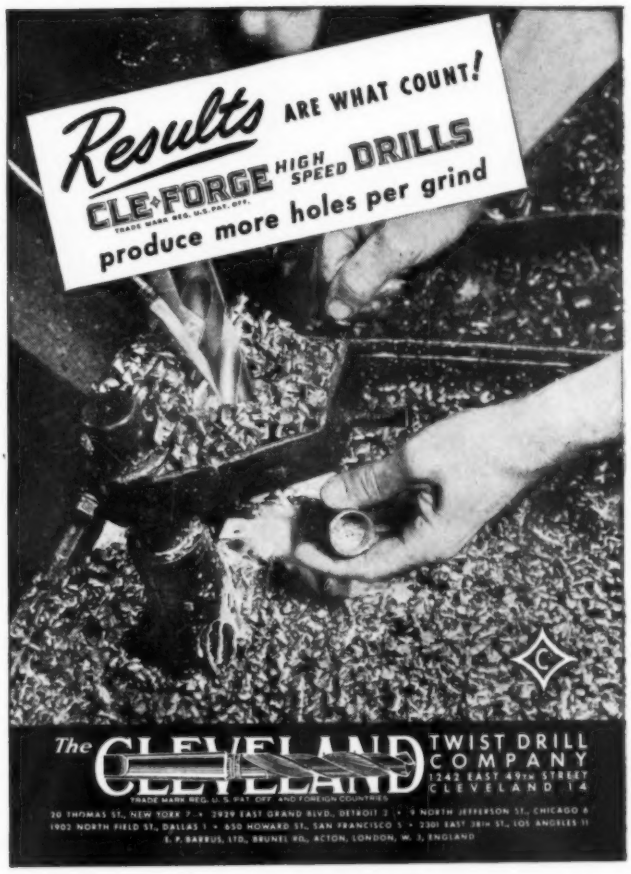
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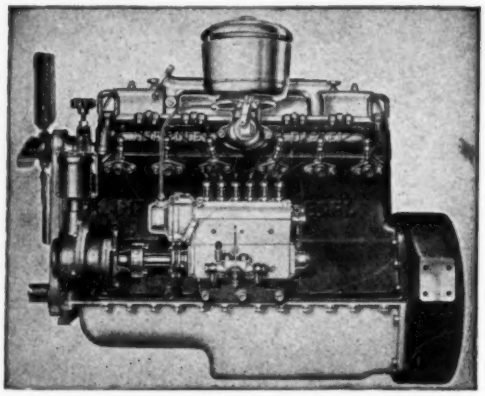

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Here at Hoover we're back again in full production of Hoover Cleaners after five years of all-out wartime service.

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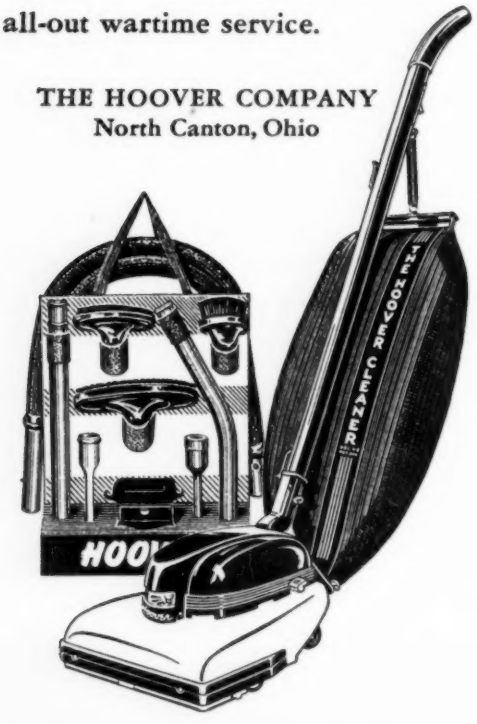

Ordnance Glossary

Some Explanatory Notes on the Ordnance Department and Ordnance Matériel—Part VI

F. W. Foster Gleason

THIS compendium of ordnance terms has been compiled as an aid to the readers of ORDNANCE and to all students of armament in interpreting the terminology of the literature. Begun in the January-February 1947 issue, the Glossary is concluded with this installment.—THE EDITORS.

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tetryl: An explosive of great strength and brisance, it is very stable but too sensitive to be used in large masses; widely used as a booster for other explosives.

thermit: A commercial welding mixture (of aluminum and iron oxides) widely used as filler for incendiary grenades and bombs.

trinitrotoluene (TNT): A high explosive of relatively great strength and stability.

torsion-bar suspension: A type of vehicle springing which utilizes the twisting (torsional) action of spring-steel bars or rods to which the idler wheels of a track-laying vehicle are suitably attached.

tracer: A pellet of brightly burning composition placed in the base of a projectile to show or "trace" its flight.

transport vehicle: A motor vehicle, armored or unarmored, and armed for defense (if at all), designed for the transport of matériel or personnel.

traverse: Angle of horizontal movement of a weapon without moving its mount.

trunnions: Two opposite cylindrical projections on a gun tube or its supporting cradle forming an axis for elevation and depression.

tube: The barrel of an artillery weapon, not including any component part of its mount.

undercarriage: The base of an artillery mount upon which the top carriage (sleigh, cradle, etc.) recoils.

VT fuze: The radio proximity fuze, one of the outstanding developments in the ordnance of World War II. It is simple in principle but complex in design and manufacture. It contains a tiny radio set (broadcasting and receiving), together with the power plant thereof. It broadcasts a continuous wave which, on approach to the target (plane, ship, ground, or the like), is reflected back to the fuze radio and is superimposed on the outgoing wave. This sets up a beat frequency whose amplitude is increased as the target is neared.

At a suitable distance, determined by the design characteristics of the fuze the amplitude of this doppler frequency is sufficient to activate the fuze and detonate the charge. (*Concluded.*)

ERRATA.—"PETN" (in July-August 1947 issue, p. 50): delete "of comparatively recent development."

"Mark (Mk.)"—(*ibidem*, p. 48): "Mark" was changed to "M" in U. S. Ordnance nomenclature in July 1925 on all new items. In December 1944 the U. S. Navy and British forces discontinued the use of Roman numerals. The Ordnance Department did not modify the actual marking on Navy or British ammunition.

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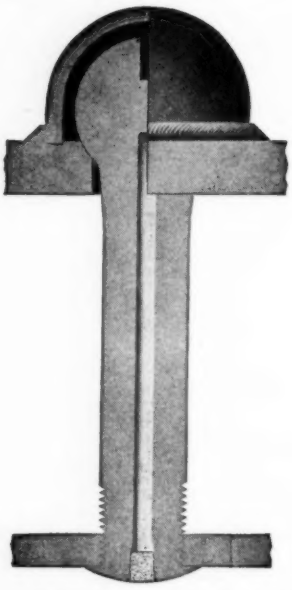

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BRIG. GEN. R. H. SOMERS, *engineer, ballistician, author, editor, Dover, N. H.*

COL. THOMAS K. VINCENT, *artillerist, engineer, author, Germany.*

WEAPONS OF WORLD WAR II. By Maj. Gen. G. M. Barnes. New York: D. Van Nostrand Company. 317 pp. $7.50.

THE task of providing ultramodern and effective weapons for our armies and the United Nations in World War II was of such vast scope that it is difficult adequately to discuss it in a single volume. Yet General Barnes has succeeded very well in presenting the Ordnance achievement in various research fields, in illustrating the text with superb developmental and action photographs of many different kinds of weapons, in giving their characteristics, and in outlining the highlights of their progress from drafting boards to global battle fronts.

The book is divided into seven major chapters: small arms and small-arms ammunition; aircraft armament; ammunition; artillery; rockets and launchers; tanks, gun motor carriages, and motor transport; and research and materials. An introductory chapter describes the purpose and function of the Ordnance Department while a concluding chapter outlines Ordnance's postwar plans.

This highly interesting and informative volume on the achievements of the Science-Industry-Ordnance team is authoritative, as complete as possible, handsomely illustrated, and carefully indexed. It will interest all those who designed, produced, or used American weapons and combat equipment in World War II.—JOHN J. O'CONNOR.

RIMFIRE RIFLEMAN. By Edwards Brown, Jr. Harrisburg: Military Service Publishing Company. 320 pp. $4.

AFTER a careful and interested reading of this book, I find that it has one big drawback—the title doesn't tell anywhere near enough about what's in it. It ought to be called, "Introduction to Shooting," or "Invitation To Shoot—With Useful Information for Every Shooter from Tyro to Expert," or some other unwieldy but reasonably informative title.

It's obvious, on first opening it, that it is well designed. A book full of information that no one can find is a constant source of annoyance, but "Rimfire Rifleman" is a remarkable combination of an interesting story and a well-arranged reference work. It achieves this result by dividing its content and devoting about its first third to the fictional account of one family's introduction to the art of shooting. (*Continued on p. 196.*)

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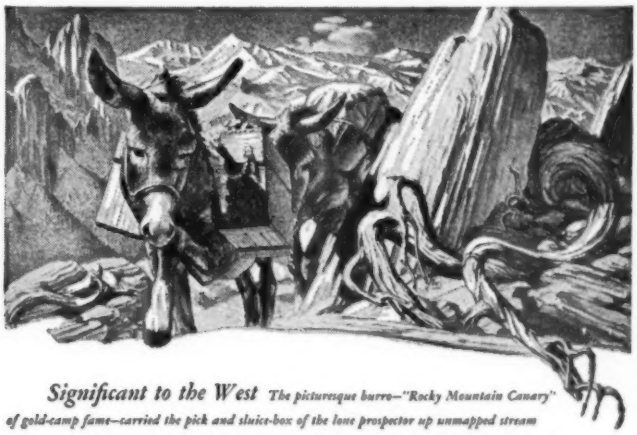

Significant to the West *The picturesque burro—"Rocky Mountain Canary" of gold-camp fame—carried the pick and sluice-box of the lone prospector up unmapped stream beds in search of gold and silver, made up the pack trains which returned from the mountains with the mined metal. The regard of the "rock hound" for his burro is typified by the monument over a burro's grave on the main street of Fairplay, Colorado.*

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This is a well-balanced combination of an interest-retaining yarn with a lot of actual first-class dope on how to shoot.

The other two-thirds of the book consist of a relatively short but comprehensive treatment of well-classified subjects of general interest to all shooters. These run all the way from a glossary of terms through the rifles themselves, sights, ammunition, some good simple ballistics data, and actual target-shooting records, down to and including how to cook the game you have killed.—MELVIN M. JOHNSON, JR.

THE NEW YORK ORDNANCE DISTRICT IN WORLD WAR II. By Col. Chester Mueller. New York: New York Post, Army Ordnance Association. 243 pp. $5.

IN reading this history, those who worked in and with the New York Ordnance District will see their labors in perspective and, with pardonable pride, will relive their former associations. In addition, and even more important, future students of industrial preparedness will find in it an authoritative description of the many and varied aspects of Ordnance district operations.

The history is divided into three parts: the first, a chronological story beginning with World War I; the second, a discussion of district functions and operations; and the third, a compilation of rosters and statistics. The story closes with December 31, 1945.

The author began his association with the district in 1925 as a Reserve officer and participated in its activities with distinction both in peace and war. In this history he has rendered another outstanding service to his former Ordnance associates and to the Nation.—JOHN J. O'CONNOR.

TROOPSHIPS OF WORLD WAR II. By Roland W. Charles. Washington: The Army Transportation Association. 374 pp. $3.25.

THE global aspect of World War II, with U. S. troops fighting in widely separated theaters literally all over the face of the earth, gives this book a place among the important logistical war records of the United States. The water transport of millions of troops to far-flung overseas theaters of operations was an undertaking of gigantic proportions, brilliantly executed, although necessarily carried on during the war with the greatest possible secrecy.

It is now permitted to release much information of this nature heretofore withheld from the public. This book contains the official photographs and basic descriptive data of the 358 troopships which comprised the mighty fleet which carried our armies overseas during the war and brought them back after the armistice.—BURTON O. LEWIS.

PRACTICAL DOPE ON THE .22. By F. C. Ness. Harrisburg: Military Service Publishing Company. 313 pp. $4.

THE thousands of people who know the author from his many years of service on the technical staff of *American Rifleman* will know what to expect from his latest book. Theories and probabilities don't interest Ness when it comes to guns; he uses only facts proved the hard way by himself or other reliable authorities.

Until such a book as this is read, it is difficult to realize what an enormous number and variation of loads are comprised in the modern category of caliber .22 ammunition. Ness quite convincingly computes the number of today's shooters in America at 24,000,000. And this reviewer is impressed with the simple fact that the thousands of them who seriously experiment and work with these small-bore, high-speed loads and rifles are not only shooters, but true ordnancemen.

Essentially, this book is a highly technical and exhaustive work, but so much down-to-earth experience and advice is given as well that it will bring delight to the shooter, hunter, or just plain gun lover. That there was too great haste made in com-

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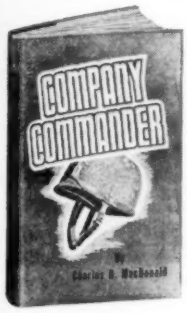

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MATERIALS HANDBOOK

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This is the sixth edition of Colonel Brady's popular encyclopedia for purchasing agents, engineers, executives, and foremen. A new feature of the present edition is an arrangement of physical data for the convenience of procurement officials. Retail price $7.00. To members $7.00.

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Colonel Marshall has written a concise and astounding critique of American leadership in World War II. One of his observations is the fact that in an ordinary fire fight only 15 to 20 per cent of the men will use their weapons—a clear loss of 80 per cent of American firepower. His book is full of actual, factual material, valuable and astounding. Retail price $2.75. To members $2.34.

WEAPONS OF WORLD WAR II

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This great new book is of especial interest to all those who designed, produced, or used the American weapons and combat equipment that defeated the enemy in World War II. A limited number of copies are still available to members of the Army Ordnance Association at a saving of $1.25. Order now! Retail price $7.50. To members only $6.25.

THE NEW YORK ORDNANCE DISTRICT IN WORLD WAR II

by Colonel Chester Mueller

One of the basic reasons for the success of American armed forces in World War II was the decentralized Ordnance procurement district system. Colonel Mueller shows clearly how one of these great procurement centers operated under wartime pressures. The achievements of the New York Ordnance District were many and varied. Colonel Mueller's fast-moving chronicle tells the inspiring story of patriotic achievements under severe handicaps.

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piling the volume is evidenced by its typographical errors, though these cannot hide the solid years of work behind it.—F. W. F. GLEASON.

THE AIR WEAPON, 1914-1916 (Vol. II of "WINGED MARS"). By John R. Cuneo. Harrisburg: Military Service Publishing Company. 503 pp. $5.

THIS is the second volume in a series being prepared by the author. Volume I covered the period 1870-1914; this volume covers the first half of World War I.

Mr. Cuneo gives the reader background information on the initial use of air weapons (lighter as well as heavier than air) in war. During the 1914 period of World War I, the reconnaissance value of aircraft was demonstrated, and aircraft observers learned how to obtain reliable information concerning the enemy when flying conditions permitted.

The book gives information on the relationship of European armies and navies to their infant air organizations. The first use of aircraft weapons for destruction of other aircraft is described as is the first use of bombs by aircraft in the effort to show that the new machines could have independent effect on the enemy. The information contained in this book is timely in that it helps the reader who is trying to understand the present controversies concerning the proper status of the Air Forces in national defense.—PHILIP SCHWARTZ.

MATERIALS HANDBOOK. By George S. Brady. New York: McGraw-Hill Book Company. 831 pp. $7.

THIS is the sixth edition of Colonel Brady's popular encyclopedia for purchasing agents, engineers, executives, and foremen. It grew out of a need for a quick reference to basic data on all kinds of industrial materials. The collection and classification of data were then extended to cover the primary requirements of industrial executives, designers, architects, and builders of mechanical equipment and plant. Still later, the scope was extended to include the chief materials entering into international trade.

It is not the author's intention to provide an exhaustive treatise on any material, as it is assumed that purchasers and designers will consult producers of the materials for detailed specifications. A new feature of the present edition is an arrangement of basic physical data for the convenience of procurement officials who may want a ready reference to such technical facts as the linear expansion of metals, viscosity of liquids, etc.—JOHN J. O'CONNOR.

EDITOR'S NOTE.—*The article "For Modern Military Transport," by Col. C. Elford Smith, which appeared in the September-October 1947 issue of* ORDNANCE, *has been reprinted. Copies may be obtained free of charge upon written request to the Army Ordnance Association, 705 Mills Building, Washington 6, D. C.*

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